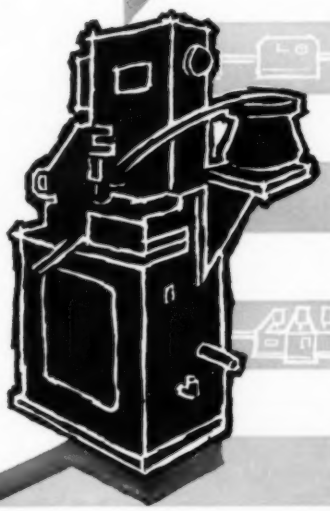
AUTOMATION

MAY 1957

Evaluating Production Equipment

FOR AUTOMATION



The Magazine of Automatic Operations

Using Standard Equipment

Applying "Building Block" Techniques

Transfer Machines

Special Purpose Lines

Tape and Card Controlled Machines

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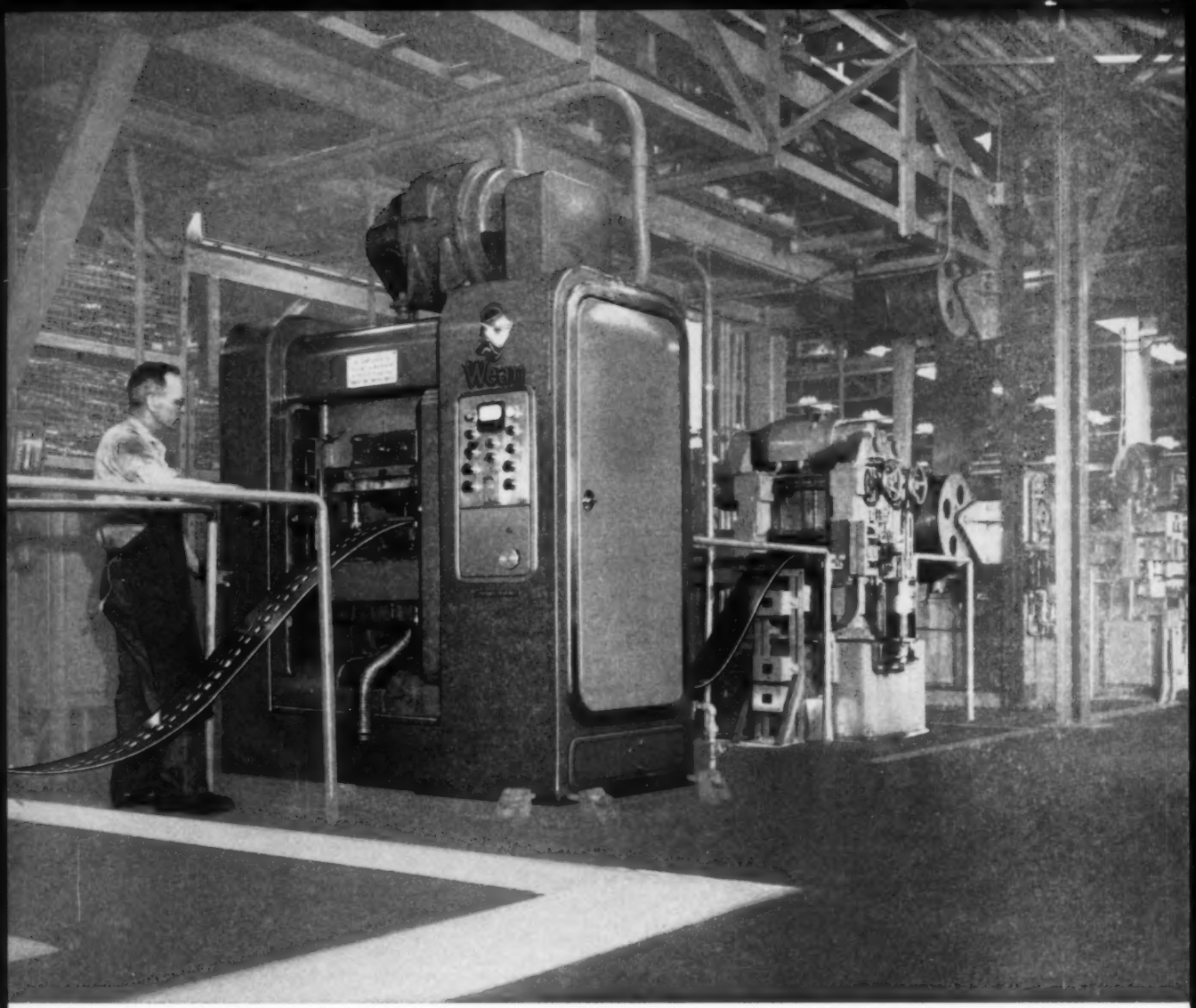

The Wean "Flying Press"

continuous strip feed eliminates stop-and-go operation in production lines

In many production lines utilizing conventional presses, the production rate of the entire line is governed by the speed of the press. Thus, though the balance of the line may have a higher production potential, actual production is curtailed by the old-fashioned stop-and-go action of the press. In the case of the Wean "Flying Press", however, the combination of a continuous feed principle plus speeds many times in excess of conventional press rates enables a production line to produce at maximum capacity.

High speed, automated and semi-automatic operations in particular benefit from the many revolutionary advantages inherent in the Wean "Flying Press".

Built in feed rolls — press feed, can be varied while press is running — all controls centralized . . . . these are but a few of the many features of the Wean "Flying Press". We could discuss simple floor mountings, ultra-high speed operation and many other advantages. However, you can get the complete story by writing today for your copy of the Wean "Flying Press" brochure.

Wean Equipment Corporation
CLEVELAND 17, OHIO

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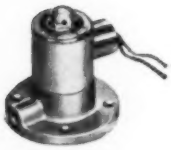
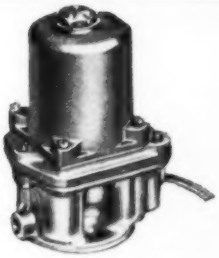
NEW Ross Starline

air control valve series

NEW long life



WHITE STAR
SPOOL SOLENOID



GOLD STAR
OIL-IMMERSED SOLENOID

BLUE STAR MV

BLUE STAR TD

BLUE STAR WV

NEW match any head to any valve body!

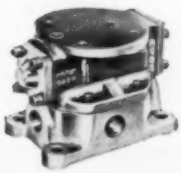
STRAIGHTWAY NORMALLY OPEN

STRAIGHTWAY NORMALLY CLOSED

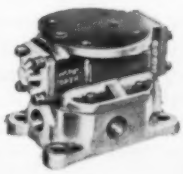
3 WAY NORMALLY OPEN

3 WAY NORMALLY CLOSED

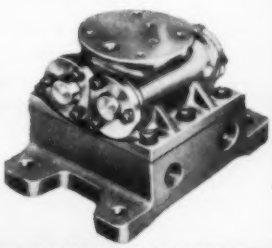
3 WAY NORMALLY OPEN



3 WAY NORMALLY CLOSED



4 WAY



Tests indicate a trouble-free life of over 25 million cycles for valves with the spool solenoid pilot section, and *more than 40 million for all other Starline* valves shown.

Heads and bodies are completely and instantly interchangeable. Sizes from ¼" to 1¼". Even *more* Starline models coming later. Write for Starline data file.

A Galaxy of New Air-Control Stars Are Coming Your Way From

Ross OPERATING VALVE COMPANY

131 EAST GOLDEN GATE AVENUE • DETROIT 3, MICHIGAN

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CHILE COLOMBIA PERU ARGENTINA PORTUGAL SPAIN SWEDEN U.S.A.

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FREE ENTERPRISE IN 24 NATIONS UNITED...

on Choice of Yoder Mills for Pipe and Tube Manufacture

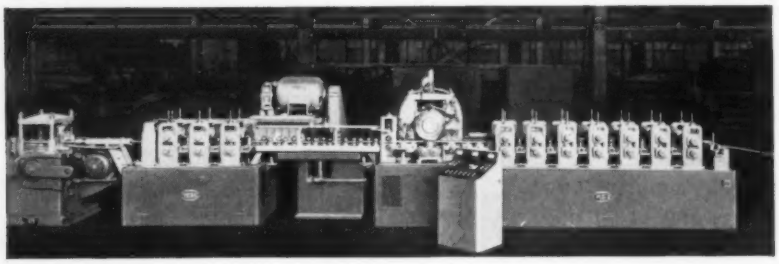
It all started less than two decades ago with the introduction by Yoder—and the rapid adoption by American industry—of a revolutionary new type of mills for cold forming and electric-resistance welding of pipe and tubing. England, France, Italy, Mexico, Argentina, and Brazil soon followed the U.S.A. in adopting Yoder mills. Most other countries which boast any kind of modern metal working industry also invested in one or more Yoder mills, including distant Japan, India, and South Africa. Production, depending on requirements, varies from 25,000 up to 75,000 feet per 8-hour shift.

By this time, England, Italy and Argentina each have a total of ten Yoder mills in operation; Brazil, eight; Mexico, six; France, five; other countries somewhat in proportion to their population. In many nations, Yoder mills now supply from 50% to 90% of all the welded tubes used.

The geographical distance which separates Yoder from many of these countries has proved much less a handicap than might be supposed. Reasons: the simplicity of design, ease of operation and dependability of Yoder mills. Secondly, generous assistance rendered by Yoder in training operators everywhere. In fact, several outstanding production records have been scored by operators in foreign countries, most recently in Italy.

Through technological advances, Yoder leadership in tube mill design has been jealously preserved and strengthened from year to year. Ask for literature giving details of the latest improvements. Correspondence invited.

THE YODER COMPANY
5526 Walworth Ave., Cleveland 2, Ohio, U.S.A.



ENGINEERING **YODER** MANUFACTURING

PIPE AND TUBE MILLS (ferrous or non-ferrous)
COLD ROLL FORMING MACHINES
ROTARY SLITTING LINES

MAY 1957
Vol. 4—No. 5

AUTOMATION ®

A PENTON PUBLICATION

The Magazine of Automatic Operations

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automation outlook

TOP INDUSTRY

". . . we are engaged in a second industrial revolution, the era of automation. This time it is not man's muscles that are to be replaced and extended, but rather man's brains . . . and anyone who is foolhardy enough to challenge the idea that the replacing of man's brains will be the top industry in the nation some years hence is in danger of having his brains among the first to be replaced . . ."—*Simon Ramo, executive vice president, the Ramo-Wooldridge Corp.*

CONVENTIONAL MACHINES

". . . the integrated line consists essentially of conventional machine tools tied together with readily available, easily designed, materials handling equipment and an automatic control system for the purpose of safety interlocks and some rudimentary information handling . . ."—*D. A. Cargill, president, Cargill Detroit Corp., see page 65.*

UTILIZE BUILDING BLOCKS

". . . in either case the end result is the same. A series of standard components, or building blocks if you prefer, will be utilized time and time again in the construction of special purpose machinery . . ."—*P. H. Richardson, engineering vice president, the Hartford Special Machinery Co., see page 70.*

TRANSFER MACHINE POSSIBILITIES

". . . transfer machines have been applied to an endless list of products and operations. Transfer machines have reached a high state of development and today offer outstanding possibilities . . ."—*Val Wallace Baran, industrial engineer, the Cross Co., see page 74.*

SPECIAL PURPOSE LINES

". . . in order to produce high production products at a minimum cost you must keep capital investment down, floor space at a minimum and labor to a minimum. The special purpose line is often the only answer . . ."—*Robert Sattler, vice president, La Salle Tool Co., see page 79.*

DOMINANT FACTOR

". . . thus, numerical control is approaching the point where the user will become the dominant factor in determining the future of the concept. This is also true in the area where problems now appear to exist. For instance, such problems as standardization will in the long run be solved naturally by what the majority of users prefer . . ."—*John H. McRainey, associate editor, AUTOMATION, see page 83.*

WHAT IS IT?

". . . automation is simply a newly-coined word to describe an old, old process. Automation cannot be said to have begun on any certain date, nor can it be said that it will end at any definite time. It is in truth but a phase of our continuing technological advance. It is just more of the kind of stuff which has been taking work out of work and creating more and better jobs all the time. Put very simply, automation is the continuing improvement in the tools we use and have been using. . ."—*Cledo Brunetti, director, Engineering Research and Development, and George Geick, assistant manager, Systems Dept., Mechanical Div., General Mills Inc.*

AUTOMATION

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BPA NBP

Sets a New High in Automatic, High-Volume Production

A typical example of one Jones & Lamson approach to "automation" is this line. Here is completely automatic handling with both machine transfers and inter-machine transfers. In this line are 4 Fay automatic lathes and 1 milling and center-drilling machine. J & L machines of this type have been in use for many years in production plants throughout the world.

The simple, rugged transfers used in this line were designed, engineered and built by J & L. Control combinations are, of course, tailor-made for each individual application.

Automatic handling is also adapted to grinding operations, as shown by this J & L Model "E" Grinder (inset photo) which handles 136 steering worms per hour.

Send for Catalog No. 56. JONES & LAMSON MACHINE COMPANY, 532 Clinton Street, Springfield, Vermont.

JONES & LAMSON "AUTOMATION"

Turret Lathes • Fay Automatic Lathes • Milling & Centering Machines • Optical Comparators • Thread Tools Thread & Form Grinders

the man who needs a new machine tool is already paying for it

New Snyder Special Transfer Replaces Automation in Processing Forged Steel

Special Features of Snyder Machine No. 55-44

1. Production: 146 pieces per hour.
2. 26 Stations: 28 Operations per piece: 2 milling, 1 sawing, 4 hollow milling, 3 reaming, 1 countersinking, 10 drilling, 5 spotfacing, 1 threading and 1 tapping.
3. Palletized fixtures each carrying two parts.
4. Parts quickly and accurately clamped and located and unclamped by combination torque wrenches and hydraulically operated mechanisms at Stations 1 and 26.
5. Ten individual base segments provide maximum flexibility for future part design changes.
6. Ample room between segments for tool changes and maintenance.
7. Motorized fixture return conveyor with fixture washing unit.
8. Ample chip and coolant facilities.

Standard Features of Snyder Machines

1. SNYDER SELF-CONTAINED UNITS and other units equipped with hardened and ground ways.
2. Threading and tap heads equipped with individual leadscrew spindles.
3. Minimum downtime for tool changes because spindles are arranged for pre-set cutting tools.
4. Standard and special parts interchangeable for speed and economy in maintenance.
5. Motorized automatic lubrication system for all moving parts.
6. Construction to J.I.C. Standards throughout.
7. Master Push Button Panel and Light Console at Station 1.
8. Each unit equipped with its own push button control station for ease of tool setup and manual operation of unit.
9. Electrical interlocks and full depth circuit throughout.
10. Panels equipped with SNYDER CIRCUIT SLEUTH.

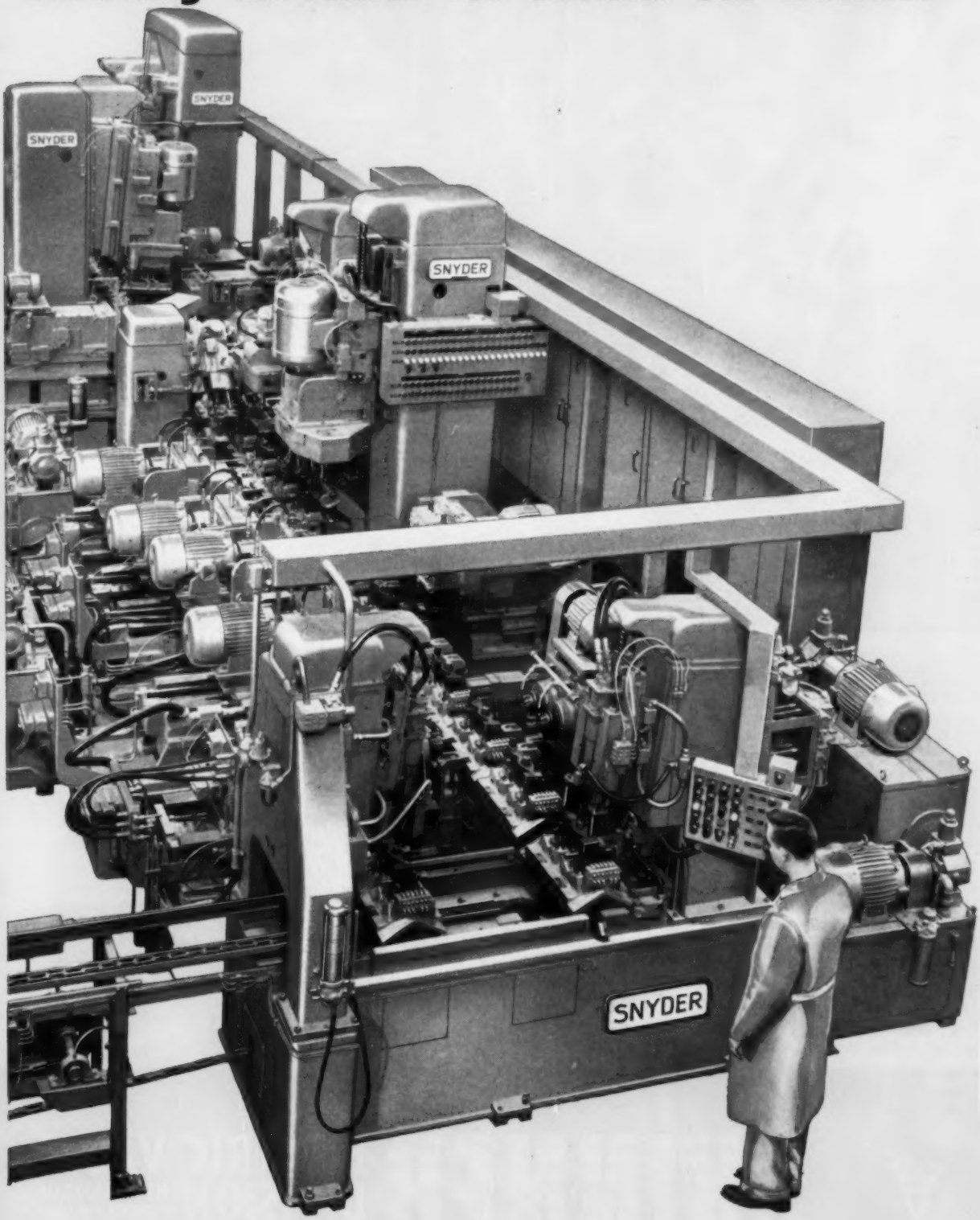
SNYDER

TOOL & ENGINEERING COMPANY

3400 E. LAFAYETTE • DETROIT 7, MICHIGAN

32 Years of Special Machine Tools with Automation

Several Semi-Standard Machines with Steering Knuckles for British Car Builder



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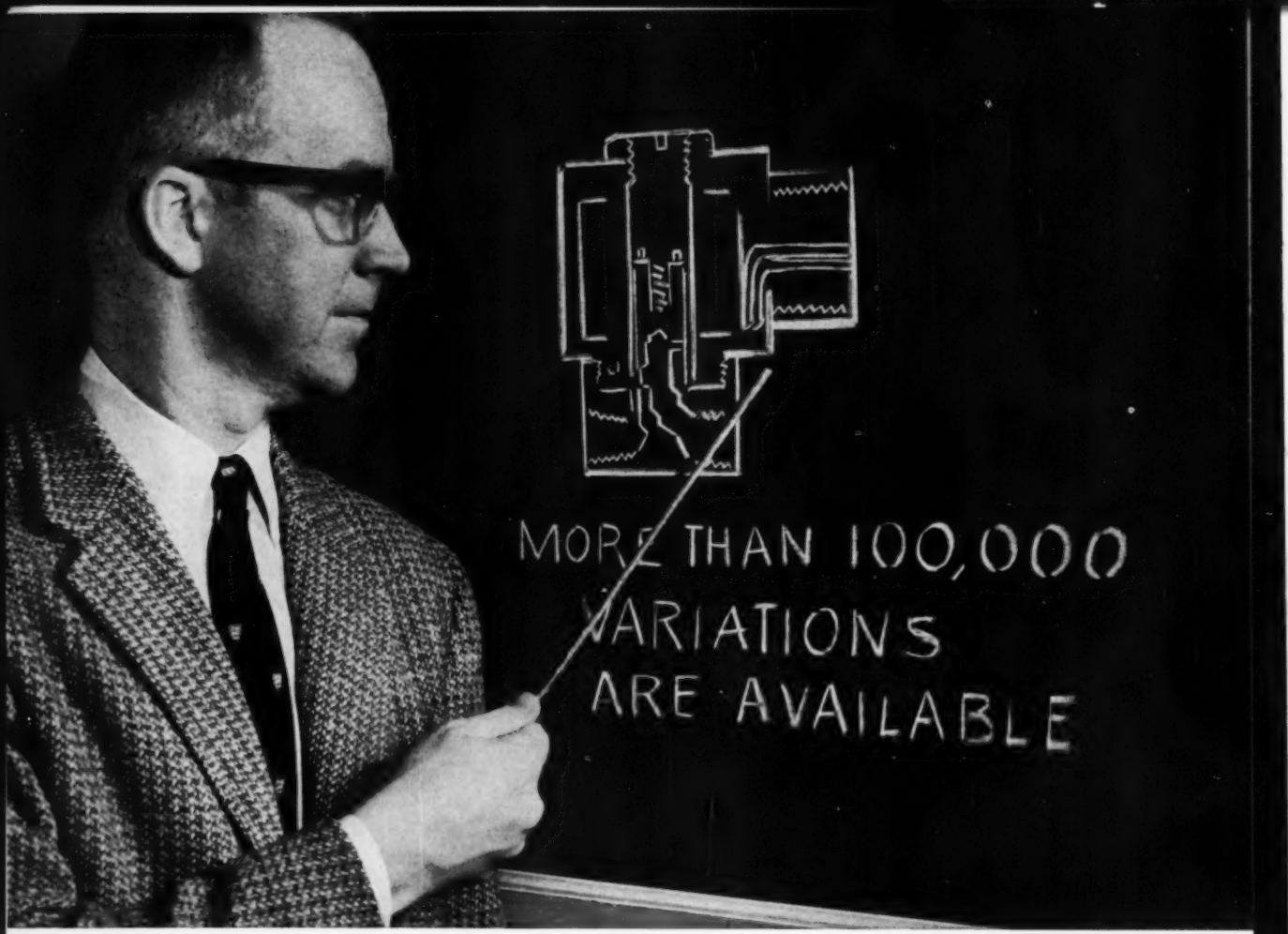

You can get the *custom designs* you want from a basic Skinner Solenoid Valve

In the small-size solenoid valve field, Skinner offers a wider variety of variations and optional features than any other manufacturer. Take, for example, the standard V5 model shown above in cutaway form. Its design is so flexible that the valve can be supplied for applications which would otherwise call for "specials." So, if you have a solenoid valve problem, we urge you to talk to a Skinner representative. Tell him your requirements in regard to port sizes and locations, voltages, pressures, temperature conditions, flow adjustments and mountings. Let him show you how easily he can select the valve you need.

When you specify Skinner, you get custom design plus outstanding service performance. Continuous testing in our labs and actual results in the field prove that Skinner valves have exceptional leakproof life. For complete information on Skinner's line of 2-, 3- and 4-way valves, write us or contact a Skinner representative. Write Dept. 325.

Skinner Solenoid Valves are distributed nationally

See us at the Design Engineering Show, Booth 708.

SKINNER ELECTRIC VALVES

SKINNER ELECTRIC VALVE DIVISION

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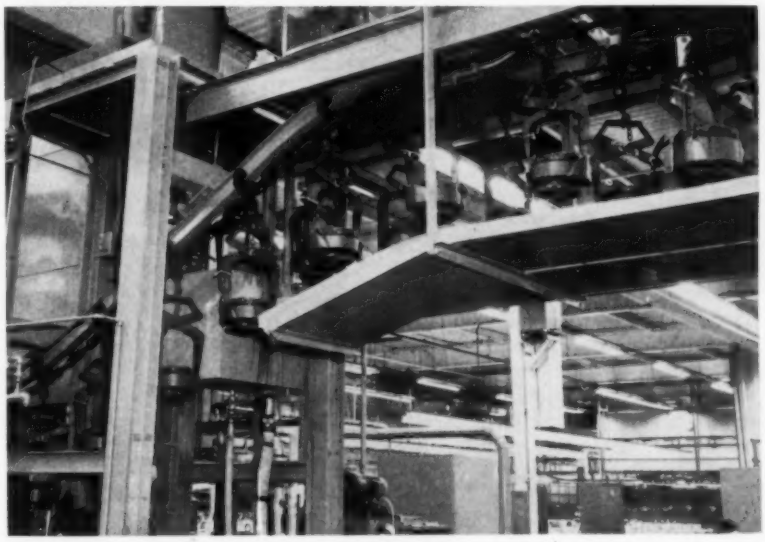
AUTOMATION news

Today's events and developments in the field of automation

Co-ordinated Work Handling A Feature of New Motor Plant

INCREASED demand for electric motors is reflected by new plant addition to the Ashtabula Div. of Reliance Electric & Engineering Co. The electric motor can well be described as a tool of automation, and to give industry this tool, the company has applied the principles of automation to the manufacture of motors in the 1 to 40 horsepower range.

An outstanding example would be the small motor frame line which includes a special transfer machine for facing, boring, milling, drilling and tapping operations. The 12-station unit is capable of producing any one of 36 different small motor frames. This transfer machine will be described in detail in a future issue of AUTOMATION.



AFTER leaving preheat oven, stator coils at the new Reliance plant are automatically dipped in varnish and moved down the conveyor line for the first bake. This is followed by a second varnish dip and bake and a final finishing and sealer dip. Assembly operations on motor are synchronized with coils leaving the varnish station.

It is not simply because of the transfer machine that the new installation is said to apply the principles of automation. The reputation is based upon the unified concept which has been applied to the design, arrangement and use of all equipment and facilities in the plant. For instance, laminations are prepared from stock in coil forms; stator punchings are welded into a core on automatic equipment; oxidation and annealing of stators in conveyorized oven provide improved electrical characteristics and insulation between laminations; overhead conveyors are used to transfer parts between machines; roller conveyors are used extensively in moving motors during assembly operations; etc.

OPERATOR at the varnishing station of new Reliance plant, by means of TelAutograph Transcriber, signals five other stations to begin selecting various parts from stock and start building subassemblies for a desired motor configuration.

In the new facility, the company has adopted the philosophy of manufacturing parts for stock rather than for customer order. This system decreases delivery times for customers and provides a more even plant loading throughout the year. Component parts are stored in a flow type storage bin adjacent to the assembly area where they are removed and used on a first in, first out basis. There are separate racks for every modification.

When a customer order is received, it is processed to five areas of assembly by the Production Control Dept. Coils are wound and sent by overhead conveyor to the stator assembly department where they are joined to the stator cores coming from stock. After the coils are connected and the stator tested, they are sent to the varnish department. In a completely au-

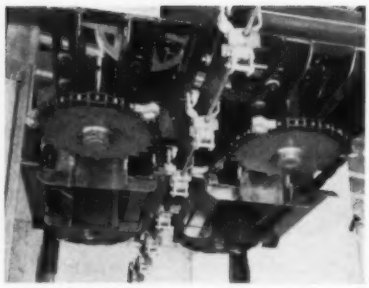
←Circle 558 on Inquiry Card

tomatic process in this department, the stators are insulated.

During the dip and bake operation in the varnish department, the operator records the job numbers in process on a TelAutograph which automatically sends the information to the other five assembly areas. This serves as notification to the other areas that the stators have reached that point and further assembly operations will be co-ordinated with the stators in the sequence indicated by the TelAutograph.

With the sequence established, frames can be withdrawn from storage and placed on the conveyor in the allotted sequence. End parts are also sent along conveyors in sequence toward final assembly. The shipping department is notified and begins to prepare bills-of-lading and shipping papers for the motors. The rotors and shafts are released in the same sequence to undergo final processing and shipment to assembly. Also at this point, production control makes a note on the face of the customer order and can answer any inquiries concerning the status of the order. The TelAutograph was located at the varnish station because the time required to finish the stator core balances out with the time required to assemble the rotor and shaft, and with the TelAutograph signaling key areas, all components will arrive at final assembly at the same time.

MERGER of the Motch & Merryweather Machinery Co. of Cleveland, and the Avey Drilling Machine Co. of Cincinnati has been announced by the respective company presidents, **Richard W. Banfield** and **Donald A. Patterson.** The Avey Drilling Machine Co. is a well-known producer of special transfer and indexing machines, drilling, reaming and tapping equipment. Motch & Merryweather has been a distributor for Avey for nearly 50 years. Motch & Merryweather is a leading designer and builder of special automatic transfer machines, precision cut-off saws, saw blades and saw blade grinding machines.



CATERPILLAR drive for their cable conveyors has been developed by E. W. Buschman Co. The drive has two strands of precision chain with special dogs that engage the cable and trolley with equal pressure from both sides. Movement is smoothly transmitted to cable during engagement, and there is no tendency for the trolley to cling to the drive dogs on disengagement. Applied on straight runs of conveyor, the drive allows large radius traction wheel turns to be used elsewhere in the system, which means that bulky loads can be handled on close hook centers.

Under the merger, the Avey Co. will be known as the Avey Div. of Motch & Merryweather, and will operate as a separate unit, retaining its present facilities, management and personnel.

Capital Expenditures Outlook Compares To 1956 Record

BULLETIN of the American Institute for Economic Research reports that general business activity will continue to receive support throughout the year from the capital goods sector of the economy if the investment outlays anticipated by business for 1957 are made. On the basis of data reported earlier in the year, it is anticipated that business will spend more than $37 billion in 1957 for capital items. The report notes that this amount is 6.5 per cent more than business spent for plant and equipment in 1956, but the increase is less than the 22 per cent increase of 1956 expenditures over those of 1955. If allowance is made for the higher prices of capital goods, then the planned replacements of and additions to plant and equipment during 1957 will only be about 3 per cent larger than 1956.

It is also noted that expenditures planned by individual industries vary more widely from their expenditures in 1956 than their expenditures in 1956 vary from those in 1955. In general, large increases in expenditures by manufacturing industries last year are being followed by substantial increases this year. Most noteworthy among this category are those of the primary metals, machinery and transportation equipment other than automobile, chemical and petroleum industries. Among the nonmanufacturing industries, the largest increases in anticipated expenditures are those of the electric utility, railroad, air transportation and communication industries.

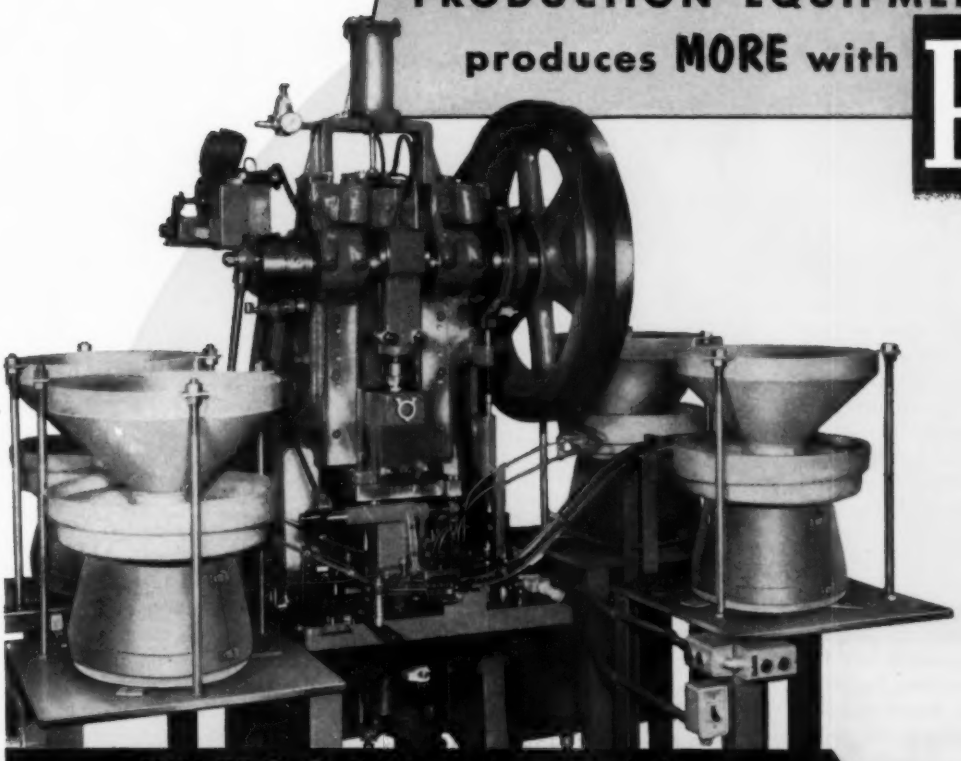
Passenger Conveyor Belt

FEASIBILITY of movement of passengers by conveyor belt has been emphasized by a recent installation at the Weirton Steel Co., a division of National Steel Corp. Installed by the Stephens-Adamson Mfg. Co., a system consisting of a series of four inclined (14 degrees) conveyor belts conveys workers from the operating floor of Weirton's mill to locker room facilities, 3½ floors above. The 24-inch wide conveyor belt glides over a slider or smooth steel deck. As a safety measure, metal ballustrades have been provided on either side of the belt and moving handrails have been added to give passengers maximum stability during the ride. The unit is reported considerably less costly than elevators or escalators and as it has few moving parts, little maintenance should be required.

Small Tape Programer Handles Thirteen Channels

MULTIPLE channel programing device development of Photographic Products Inc., Anaheim, Calif., meets an often-expressed need for such a device of requisite accuracy. The unit weighs only 3 lb 10 oz and measures 2 by 3 by 6 inches in size. The general operating principle provides for an insulating tape similar to 35 mm photographic film to be advanced at a precise rate of speed between 13 contactors. The tape is marked lengthwise in time and divided into 13 channels. Thus, up to 13 types of signals may be generated by this device for the accurate control

PRODUCTION EQUIPMENT... produces MORE with Peeco



NOW V & O PRESS equipment includes DEVELOPED PEECO FEEDERS

Illustration shows the V & O inclinable press with four PEECO vibratory parts feeders and orientation track escapement. This V & O equipment, with ring type dial feed, automatically transfers four finished components for assembly at 70 SPM.

PEECO, the leader in the field of vibratory parts feeders, is contributing its share toward the greater capacities being achieved by new production equipment. We are glad to include, among the companies in this field now being served by PEECO, the V & O PRESS COMPANY, a division of Emhart Manufacturing Company of Hudson, New York, pioneers in automation since 1889.

If you want to produce more, send for bulletin #635 and ask for the name of the PEECO representative in your area.

Peeco

THE WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF VIBRATORY PARTS FEEDERS

PERRY EQUIPMENT & ENGINEERING CO.

ERIE, PA. • • • DIVISION OF AUTOMATION DEVICES, INC.

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of a group of electrically operated equipment as punched holes in the control tape allow the contactors to close for a period of time equal to the hole or slot length.

New Associate Editor Joins *Automation* Staff

WITH THIS ISSUE, AUTOMATION is pleased to announce the appointment of **William E. Stalhuth** as Associate Editor. The editorial purpose of AUTOMATION is to help management, engineering and production executives understand and keep abreast of developments in automation. This is accomplished through a cross-fertilization and dissemination of ideas, both practical and theoretical, which can be profitably applied by many widely diversified industries.

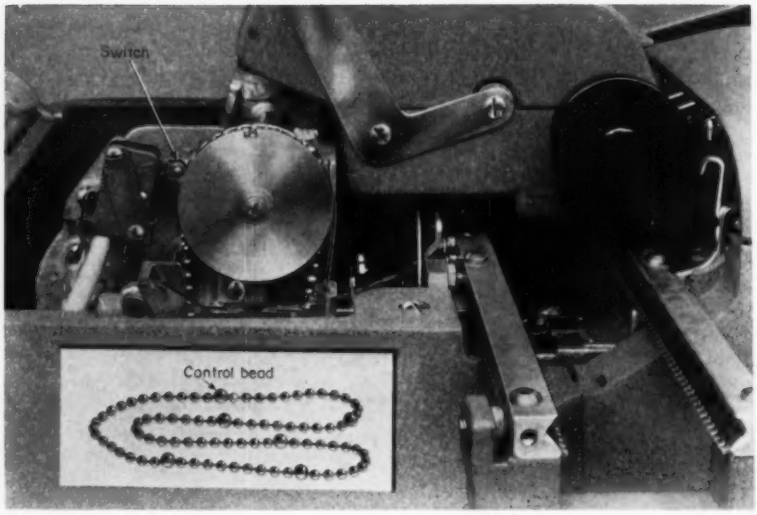
The degree of success of any magazine in fulfilling its self-appointed task is dependent on the experience of the editorial staff—practical experience which enables an editor to understand the problems confronting industry, to search out information which aids readers to solve their problems, and to evaluate events occurring in industry.

More than nine years' work in the design and development of new and improved continuous manufacturing facilities for the Western Electric Co. has given Stalhuth a splendid background in automation. His previous experience has

William E. Stalhuth

included engineering of machines, tools and layouts, and has covered all the phases of manufacturing from the selection of materials through manufacture and packaging of the final products. He is a mechanical engineering graduate of New York University, a registered professional engineer in Maryland, and has studied radar electronic fundamentals at Harvard University and Massachusetts Institute of Technology. Other experience includes design engineering on aircraft and refrigeration equipment and service as radar maintenance officer, U. S. Army.

Bill Stalhuth has several outstanding patent applications and has in the past contributed articles to technical journals—facts which attest to his interest in improving things. Among his hobbies he includes golf and operating a ham radio station, when not being the proud father of a small, active boy.



CONTINUOUS form preparation, such as for billing, payroll, invoicing operations, can be considerably speeded up with a form feed device that permits automatic skipping to predetermined writing lines. Developed by the International Business Machines Corp. for installation on its Cardatype, the device utilizes a continuous loop of bead chain and a switch. The bead chains come in several standard lengths and the user clamps a larger bead around one of the smaller beads where needed. The large bead is sensed as it passes the sensitive switch to control the skipping operation.

UN Labor Agency Considers Social Aspects of Automation

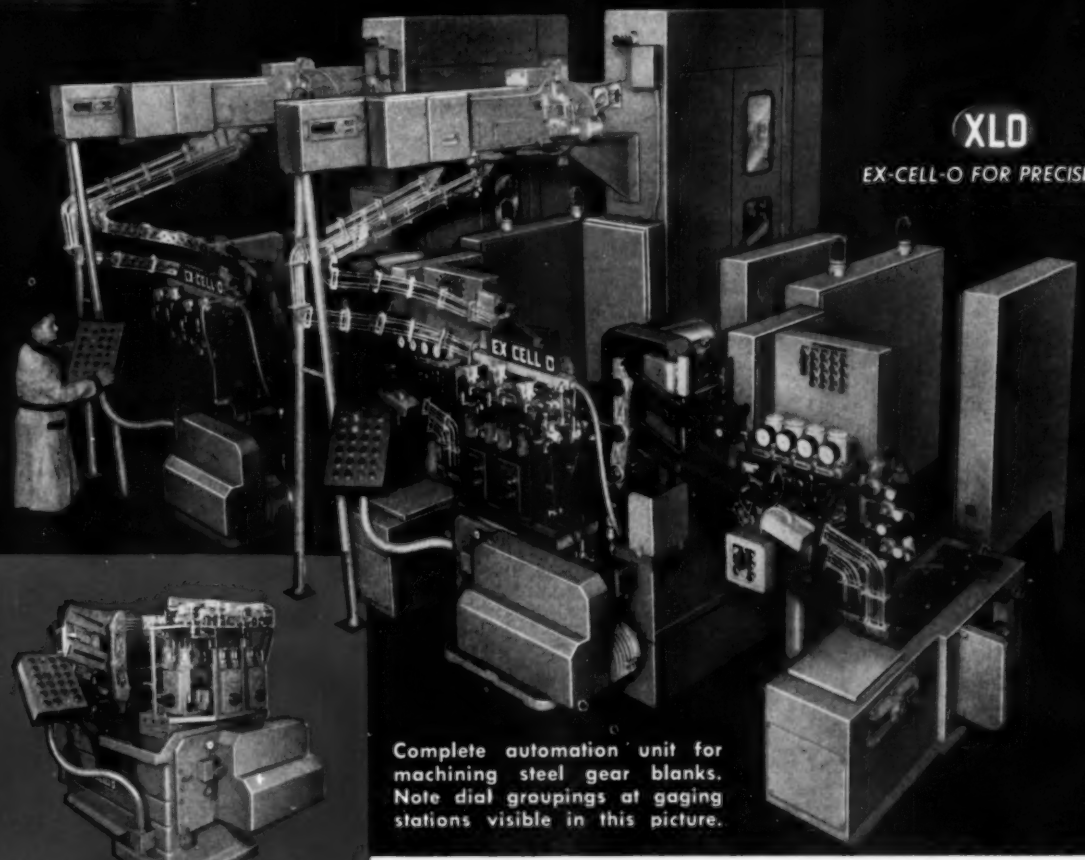
THE INTERNATIONAL Labor Organization (ILO) is a specialized agency of the United Nations, in which government, worker and employer representatives of 77 member countries work together to achieve improved labor conditions and living standards throughout the world. A recent report of the Director-general, **David A. Morse**, is devoted to social implications of automation and other technological developments. The report states that, "today there is no need to regard industrial disturbance and social unrest as an inevitable consequence of technological changeovers."

Morse points out that "The essentials of wise policy seem to be clear: Careful advance planning on the part of management, with full consideration of the human problems of technological changeovers; full prior consultation of the workers and their representatives before plans are finalized; careful timing; proper safeguards to prevent or minimize displacements and individual injustice or hardship and to assure common benefit from the innovations to be made."

Ten basic points of agreement on the controversial issue of technological developments and industrial disturbance which, Morse says, "will take us a long way forward in the search for guiding principles" are: (1) Automation, atomic energy and related technological developments make it possible to produce many goods and do many things that could not have been produced or done before. (2) They (technological developments) have given a great impetus to the achievement of higher labor standards and higher

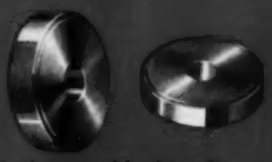
XLD

EX-CELL-O FOR PRECISION



Complete automation unit for machining steel gear blanks. Note dial groupings at gaging stations visible in this picture.

Ex-Cell-O Style 312 Cam Boring Machine adapted for automation. Components on cross slide automatically adjust tools to hold specified limits.



Typical gear blanks after automatic machining is completed.

Standard Ex-Cell-O Machines Handle Automatic Operations

Take these cam boring machines, for example: they are standard Ex-Cell-O 312s. When a customer's production schedule called for an unusually high per hour output of steel gear blanks Ex-Cell-O engineers incorporated these machines into an automated setup.

Included in the new setup: two cam-operated Ex-Cell-O Precision Boring Machines, two Gear-O-Mation storage-distribution units, three gaging stations.

The boring machines finish all the surfaces of the gear blanks: face both sides, chamfer both inner and outer edges, bore the central holes and turn the outside diameters. Tools are adjusted automatically to maintain required tolerances. Gage units automatically check parts prior to entering the machining stations, and the storage-distribution units provide space for a bank of parts at each machine station.

If you're interested in automation, but are held back by the high cost of specially designed machine tools, call your nearby Ex-Cell-O Representative today. Perhaps a standard Ex-Cell-O machine tool setup can be adapted to your automatic operation requirements. Or, if you prefer, contact Ex-Cell-O in Detroit directly.

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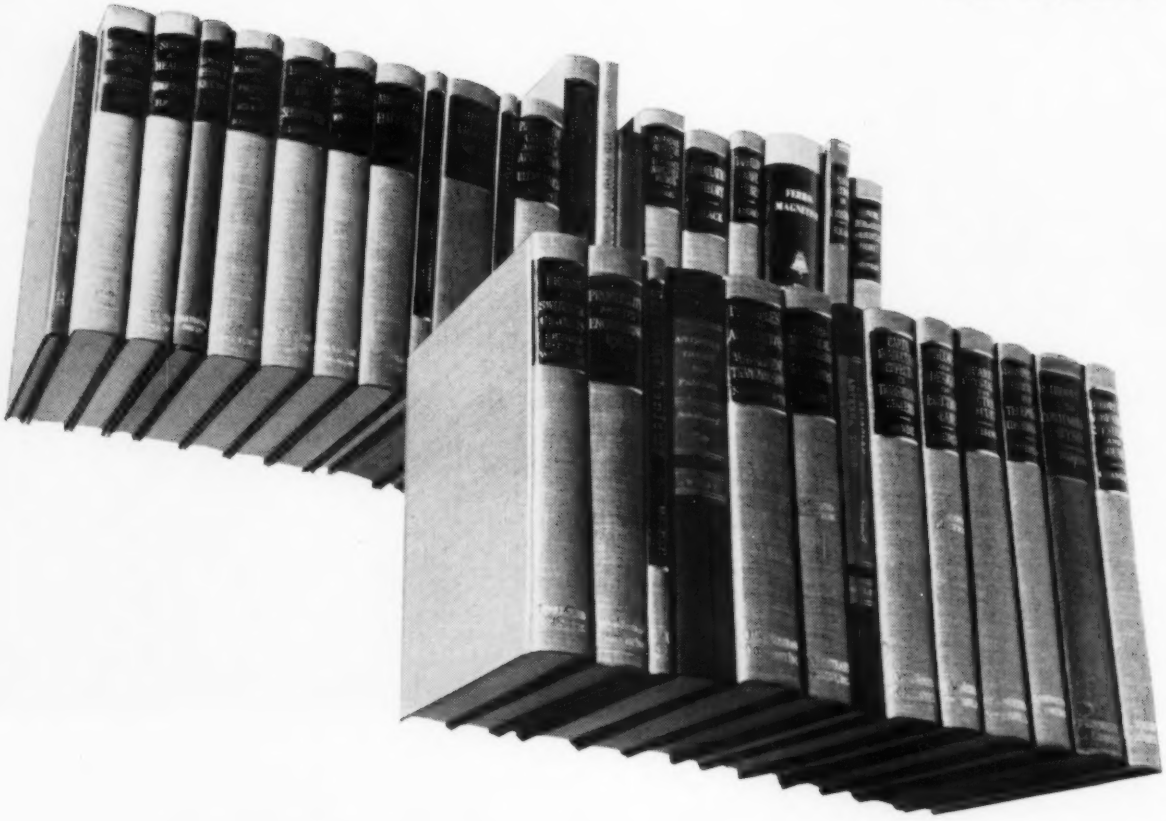
The books...



How the scientific world shares in fruits of the telephone art

In their work to improve telephony the scientists and engineers of Bell Telephone Laboratories make important findings in many sciences. They thoroughly report these findings in professional journals and magazines. But sometimes, as knowledge accumulates in a vital field, a "treatment in depth" is prepared in book form.

Bell Laboratories authors have written 36 books to date and others are in preparation. Many have become classics in the Laboratories' primary field of communications. Many have become standard works of wide application because they provide a fundamental guide for technologies in other fields. For example, the design of automatic switching systems is of primary importance in computers; statistical quality control provides the indispensable basis for economical manufacture. Through their books these scientists and engineers and the Laboratories attempt to repay benefits they receive from the published works of others.

The pictures on the opposite page show some Bell Laboratories authors of technical books. A complete listing of titles may be obtained by sending in this coupon.

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Harold S. Black, B.S. in E.E., Worcester Polytechnic Inst., author of "Modulation Theory."

John R. Pierce, Ph.D., California Inst. of Tech., author of "Traveling-Wave Tubes."

Richard M. Bozorth, Ph.D., California Inst. of Tech., author of "Ferromagnetism."

W. Thornton Read, M.S., Brown University, author of "Dislocations in Crystals."

Hendrik W. Bode, Ph.D., Columbia University, author of "Network Analysis and Feedback Amplifier Design."

Walter A. Shewhart, Ph.D., University of California, author of "Economic Control of Quality of Manufactured Product."

living standards. (3) They offer great promise for the further development of the industrially less advanced countries. (4) They need not create overall unemployment and do not themselves do so. (5) They create new employment opportunities and new skill requirements. (6) Like all technological innovations, they cause labor redistribution within the undertaking and also from one industry, occupation and undertaking to another and sometimes from one place to another. (7) They may create in some instances specific transitional problems; in particular, problems of re-employment, whether in certain localities, or for certain groups of workers (e.g. older workers, women without special skills, or skilled workers whose skills are becoming obsolete) or for certain individual workers. (8) They have a direct and immediate impact on wages and working conditions and thus on the central area of labor-management relations. (9) They have equally direct and immediate implications for the structure of social protection: For unemployment insurance and other forms of social security and for all social assistance and services designed to protect the individual worker from hardship and to promote general community welware. (10) They have thus serious repercussions for management, for trade unions, and for governments and impose on each of them new responsibilities and new tasks.

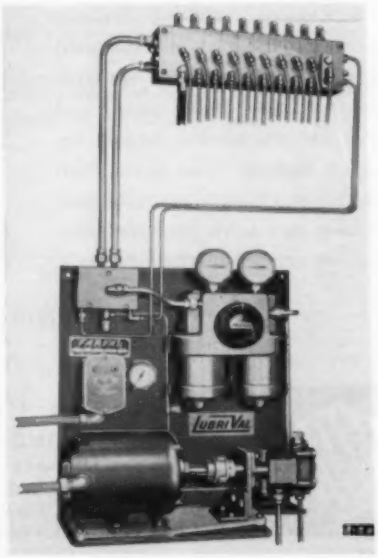
APPOINTMENT of **Wallace E. Carroll,** president and treasurer of the American Gage & Machine Co., Chicago, as director of the Metalworking Equipment Div. of the Business and Defense Services Administration, U.S. Dept. of Commerce, has been announced. Carroll is on loan from his company and will serve without compensation from the Government for a period of about six months. As director of the Metalworking Equipment Div., he succeeds **J. Robert Jones,** vice president in charge of sales for the Kearney & Trecker Corp.

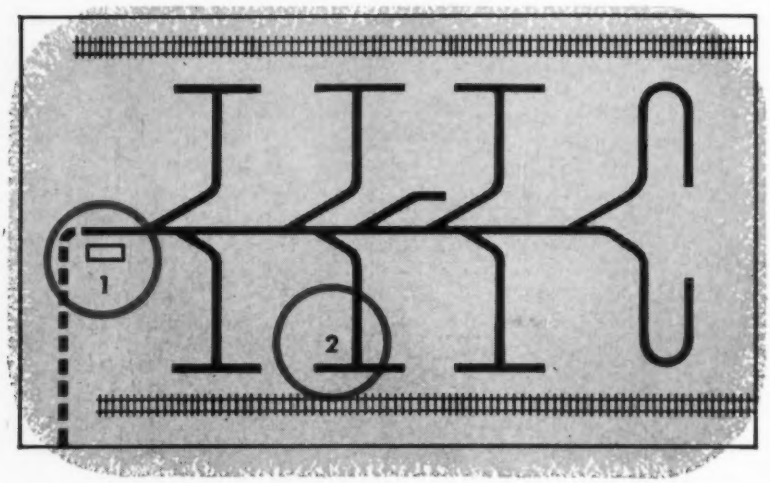
Sensitive Humidity Detector

RESEARCH in ceramics at Horizons Inc., Cleveland, O., has uncovered a ceramic which has proved to be extremely sensitive to changes in humidity. As reported by Edward Mayer, head of the Physics Dept., "We have noted that the electrical resistance of the ceramic exhibits a very marked change with ambient humidity. The change in resistance may approximate 2500-fold for a change in relative humidity between 30 and 100 per cent and may approximate a two-fold change over the range

---

NEW TYPE of circulating oil system has been developed by the Farval Corp. The design overcomes shortcomings of some designs in that it monitors its own operations through a pressure sensing mechanism to warn of clogged or broken lines in any part of the system. The equipment includes a manifold group of measuring valves connected to a reversing valve on a control panel. Other components are the high-low pressure switch, reservoir level indicator, drive motor, variable delivery pump and high pressure filter. The variable delivery pumping unit permits a wide range of selection in number of injections per minute applied to bearing points. Since each measuring valve is designed to serve two bearings, a simple external cross porting accessory can be attached at any time to merge two discharge ports into one. The design provides a circulating oil system with sufficient flexibility of flow to bearings to accommodate operating conditions, and wear-induced tolerance variations that occur during the lifetime of the equipment served.

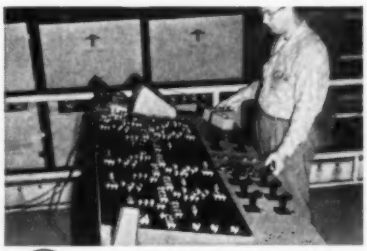




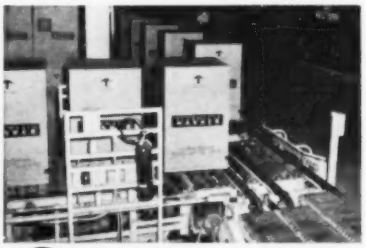
Automatic Warehouse Conveyor... handles 1200 appliances an hour

A single huge warehouse takes the output of several production buildings. A single busy conveyor line brings in trains of washers, dryers, ranges and dishwasher-sinks. As each train passes the control console, the operator pushes a button that tells the system where to deliver the train—to any one of nine spurs, serving truck dock, railroad sidings and warehouse storage. A memory system takes over and no human attention is needed until the appliances are at rest on their designated spur.

Mechanical Handling Systems conceived, designed and executed this marvelously efficient conveyor system to save time, money and space for one of the largest appliance makers. The same fresh thinking and ingenious engineering can help you solve your materials handling and production problems.



1 Push button dispatching. The control console at the start of the warehouse conveyor system. Lights on facsimile layout, on console top, report possible stoppages anywhere on the lines.



2 End of a spur serving rail siding. Appliances index onto transfer, move sideways onto gravity conveyor for loading into cars. Transfer fills left bank first, then automatically feeds to right.

Call in the MHS engineer today.

Mechanical Handling Systems Inc.
AND SUBSIDIARIES
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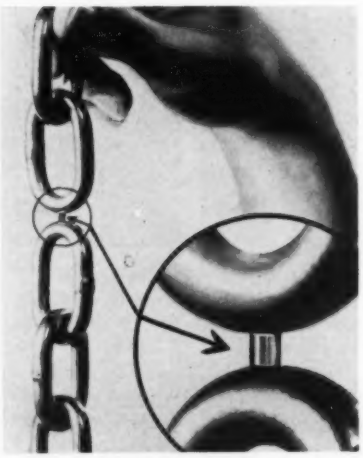
from 90 to 100 per cent relative humidity. This is in contrast to conventional sensing devices which lose sensitivity between 90 and 100 per cent and are practically insensitive at 100 per cent humidity." Some idea of the sensitivity to humidity conditions can be gained from the fact that during investigation it was noted that part of the apparent instability of its characteristics were attributable to the increase of the relative humidity in the vicinity of the ceramic caused by the researcher's hands.

Non-Competitors Form New Firm To Supply European Market

FORMATION of a new European company to manufacture and market Bellows air motors and controlled air-power devices, as well as Richardson's materials handling equipment, control panels, and automatic scales has been announced by the Bellows Co. of Akron, O., and Richardson Scale Co. of Clifton, N. J. The new company will take over the manufacture, sale, and servicing of Richardson equipment in Europe—an operation that the company has maintained in



PERMANENT magnets are finding increasingly wider uses in industry. The illustrated magnet weighs 0.0056-oz and is shown supporting a chain 215 times its own weight. Two of these magnets are used in an electric wrist watch developed by Hamilton Watch Co. The watch does not have a main spring. It is powered by a small motor which operates as current from a tiny energizer passes through a coil of fine wire fixed on the balance wheel of the watch. Through switches, reaction of current in wire and the permanent magnets causes the balance wheel to oscillate.

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Any way you look at it, the new Foxboro M/44 Pneumatic Pressure Transmitter gives you an unmatched combination of fine engineering and economy. First; because it *is* an engineered instrument. There are no attachments or "makeshifts". Second; because it utilizes standard Foxboro parts throughout—parts which have been performance-proved in thousands of successful installations of other Foxboro Instruments. And this means not only top performance, but easier servicing and stocking as well. Third; calibration is simple, right in the field, because the M/44 is "convenience-designed" by men with years of experience in every phase of instrument design and application.

In appearance, too, the M/44 has unmistakable Foxboro quality. Features like the high-legibility indicator scale, the compact drawn-steel case with tough polyester plastic cover. It's the neat, high-efficiency, low-cost pressure transmitter for centralized operation or control. All standard ranges.

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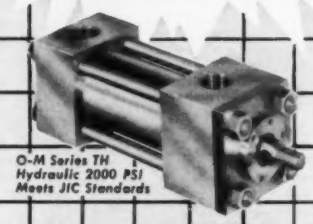

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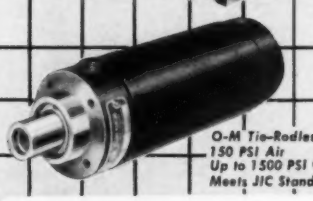

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O-M Tie-Rodless Cylinders (Round Line)—150 PSI Air—Up to 1500 PSI Oil—Compact in design "To Fit Where Others Won't"—with the lowest co-efficient of friction and easily serviced when necessary. Versatile mounting and port orientation.

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IMPROVED panel board control system for automatic blast furnace charging has been developed jointly by Cutler-Hammer Inc. and Arthur G. McKee & Co. Basically, the new system consists of three panel boards which contain circuits, switches, relays and other components necessary for guidance and control of all charging operations from time iron ore, limestone, and coke are taken out of their respective bins until material is dumped into the furnace. Included in the steps controlled by the system are the measuring of the coke, the conveying of material on a skip hoist to the top of the furnace, discharging it onto a small bell, distributing and discharging it onto a larger bell immediately prior to dropping it into the blast furnace.

Geneva since 1952.

One of the chief problems of expanding into European markets has been the lack of dollars in Europe for purchasing American-made machinery. Many potential customers have money but not dollars. The Richardson-Bellows solution to the industrial-economic problem is to form a company to license the manufacture and sale of American-designed equipment in Europe. **Ingram Richardson,** president of Richardson Scale Co., notes that in addition to tapping inaccessible markets licensees have found many opportunities to sell American - made machines for American dollars through the many contacts they have made. European manufacture and sales have also in the past enabled Richardson to meet the demands of South American customers who did not have American currency.

Hot Box Detector

OVERHEATED journal boxes on railroad cars can be spotted with the use of electronic detector developed by the Servo Corp. of America. The Chesapeake & Ohio Railroad is the first railroad to put one of the electronic detectors into use. The detector units are located outside and parallel to the rails with infrared lenses angled up at 45 degrees to span the axle journals of moving railroad cars. The equipment records on tape the temperature of every journal box regardless of a train's speed. When a detector finds a journal box above a certain temperature, it flashes a warning signal to a dispatcher and at some convenient point the train is stopped for investigation. The equipment also notes the location of the car in the train and just where the defective journal is.

The detector head contains a magnetic gate that opens and closes a shutter which protects the infrared lens and keeps it clean. This gating unit requires no external power source since the wheel flange passing over it generates a voltage pulse that operates the shutter. The gating unit is located so that the amplifier operates only when the journal is viewed by the detector, and because of this, heat from other sources such as hot brake shoes, wheel rims and steam lines does not affect the detector.

X-Ray Inspection of Tubes

SPECIAL automatic x-ray machine is used by Raytheon Mfg. Co. to check electron tubes going into guided missiles, radar and other

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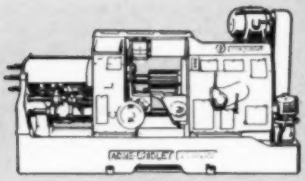
The World's ONLY COMPLETE LINE

of Single and Multiple Spindle Bar and Chucking Automatics



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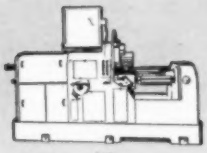

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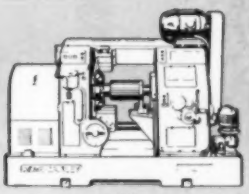
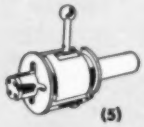


(3)

MACHINERY DIVISION: (1) Bar Automatics—4, 6 and 8 spindle models—22 sizes, in capacities from 7/16" to 7¾". (2) Single Spindle Automatics—Bar Type—4 sizes, in capacities from 3½ to 6"; Chuck Type, 12" capacity. (3) Chucking Automatics—4, 6 and 8 spindle models—8 sizes, in capacities from 5¼ to 12".

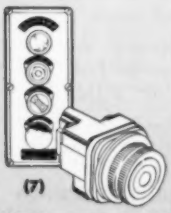
(4)



(5)

(6)

THREADING TOOLS DIVISION: (4) Vers-a-Tool Self-Opening Die Heads—capacities from 3/16" to 6½". (5) Collapsible Taps—capacities from 1 7/16" to 5". (6) Acme-Fetto Self-Opening Thread Rolling Heads—capacities from 1/16" to 2".



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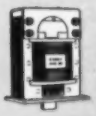


(10)

ELECTRICAL MANUFACTURING DIVISION: (7) Namco GOLD-N-RING—Heavy-duty, oil, water and dust-tight Control Station Switch. (8) Heavy-duty Push Button Switch. (9) Snap-Lock Limit Switch. (10) "Hard-Metal Weld" Solenoid—push or pull to 25 pounds.

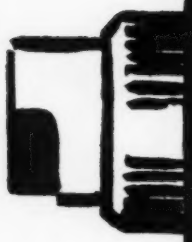
Since building the first successful multiple spindle automatic lathe in 1893, the energy and resources of the National Acme Co. have been directed toward the constant improvement and engineering to maturity of these "Master Tools of Industry". How well we have succeeded is gauged not alone by the fact that more automatics bear the NAMCO nameplate *but also by the fact that every automatic bar and chucking machine built today employs the basic principles first perfected in the National Acme prototype.*

Other National Acme "Firsts" include pioneering circular cutter threading tools to enable mass production thread cutting, introducing self-opening thread rolling heads, and building heavy-duty switches, solenoids and other electrical components—*"Built As A Machine Tool Builder Would Build Them".*

National Acme Nameplates Mean SERVICE... Anywhere... Anytime

National Acme

THE NATIONAL ACME COMPANY, 193 E. 131ST ST., CLEVELAND 8, OHIO • Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.



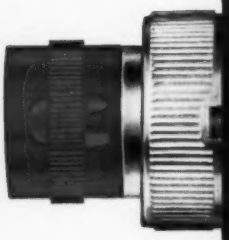
NEW PUSH-LITE* SAVES HALF THE SPACE AND REDUCES COST

Using both a pushbutton and indicating light on one operation will soon be old-fashioned. In fact, it's a waste of money and space because one new Push-Lite unit will do both jobs.

The new unique Push-Lite with its button-shaped plastic lens combines the functions of both a pushbutton and indicating light. One push transmits the appropriate signal and, at the same time, energizes the indicating lamp.

Push-Lites are liquid-tight as are other operators and lights in the Westinghouse Oil-Tite* pushbutton line. Precision-machined fits and neoprene seals will not allow liquids to reach electrical parts.

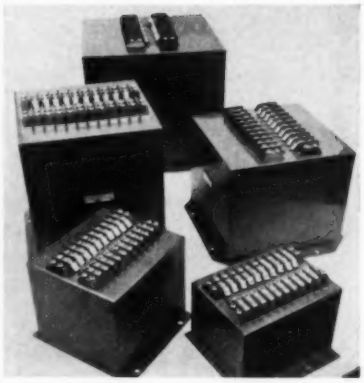
For more information about Oil-Tite pushbuttons ask for the new booklet (B-7022) or the 72-page Pushbutton Guide (B-6749), a catalog of all Westinghouse pushbuttons. Write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. or call your local Westinghouse distributor.



*Trademark J-30253

YOU CAN BE SURE...IF IT'S

Westinghouse



FORMATION of a new division responsible for design, manufacture and sales of high permeability magnetic devices for industrial control has been announced by Magnetics Inc. The division's initial line of products consists of 22 standard reactor assemblies from which electronic equipment designers can choose required assemblies. The Control Div. will manufacture both 240-volt and 120-volt 60-cycle reactors, with 11 standard sizes in each range. To supply the catalog reactors, the company will stock core units with power windings and connections ready for finished assembly. Customers will specify control windings required for their particular applications, and units will be assembled to order.

defense weapons. The detector photographs up to 18,000 special subminiature tubes per day as an aid in locating flaws. The apparatus photographs each tube from three different angles and pictures possible defects in from 15 to 20 welds associated with the 30 or more delicate parts cramped into the space only 1-inch long and ¼-inch round.

The new automatic inspection apparatus will permit a manufacturer to x-ray tubes in mass production quantities. It provides a continuous and rapid check of tube reliability. Corrective information, if necessary, can be fed back to the production line within 1 hour of inspection.

New Telephone Exchange Uses Static Switching Devices

SINCE 1946, the International Telephone & Telegraph Corp. has been studying ways of replacing the electromechanical devices, switches and relays in telephone central offices with electronic systems which would provide switching operations, and thereby reduce

"Customer Savings" is the Reason this is the Best Year in Setko's 20-Year History.

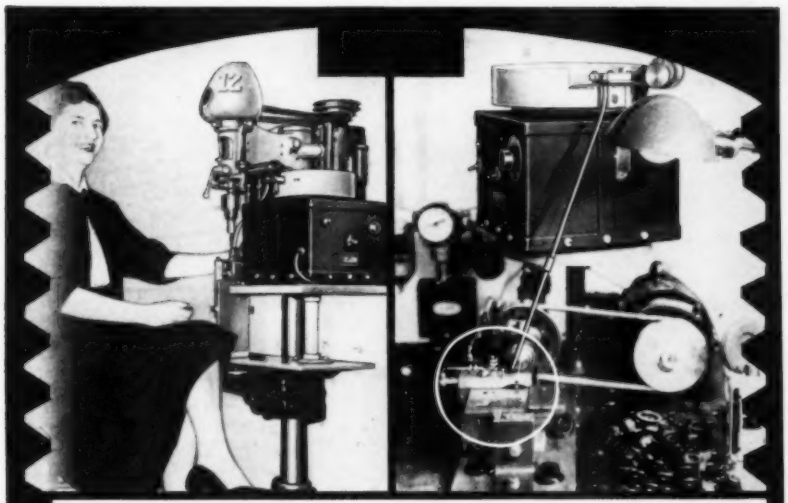
Set Screw News

& Mfg. Co.

We specialize in Solving Puzzling Set Screw Problems

Issue No. 7 | **Bartlett, Illinois (Chicago Suburb)** | **Automation Edition**

Now...New Developments in Set Screw Automation Create Greater Opportunities to CUT COSTS!



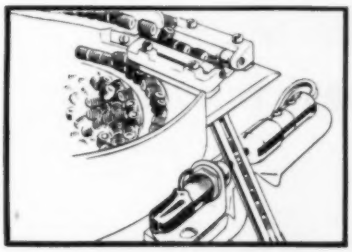
Setko System Includes Both Special Automatic Feeding Mechanisms and Specially-Designed Headless Set Screws for Hopper Feeding

The Setko System is outstandingly practical in quickly "automating" *present* operations.

The left hand photo above shows the Setko System used in a vertical feeding operation. The photo at upper right is the horizontal feed Universal Model. The adjustable work table (in circle) eliminates need for separate fixtures for each type of work. This model can also be completely automated to include automatic driving. Setko Systems provide hopper feeding of headless set screws as small as #2 (.086 x ⅛" long).

Through use of new Setko Systems—employing the exclusive Setko Automatic Hopper-Feeding Unit and specially-designed Hopper-Fed Headless Set Screws—you can "automate" many types of machines and equipment with immediate, substantial savings in each operation.

AVAILABLE IN 3 DIFFERENT TYPES OF SET SCREWS



From a vibrating hopper, this roller device automatically positions Headless Set Screws right-side-up. Available for either vertical or horizontal applications with drill presses, vertical tapping machines, rotary machines, etc. Shown is the photoelectric cell which controls the flow of screws into feed tube.

*Pat. No. 2,638,945

HEXAGON AND FLUTED SOCKET SET SCREWS | SLOTTED SET SCREWS | SLABBED SET SCREWS

NEW ...2 methods of feeding, vertical and horizontal!

NEW ...Photoelectric cell control of screw flow!

NEW ...Even nested screws can be hopper-fed!

NEW ...Microswitch control of driving!

NEW ...Adjustable work table that eliminates individual, high-cost fixtures for each type of work!

Here's why the Setko System of feeding and orienting Headless Set Screws is really "catching on" with manufacturers from coast to coast:

1. **Requires only 1/5th to 1/10th the time required for former methods**
2. **Automatically rejects misfits**
3. **Eliminates cross-threading, floor loss**
4. **Cuts set screw inventory**
5. **Takes up less floor space**
6. **Works with both metals, plastics**
7. **Takes all special Setko Set Screws, including Self-Tapping, Self-Locking, Nu-Cup, etc.**
8. **Makes possible faster deliveries**

Here's What Users Say...

"Hopper Feeding saved us $42,000 in first year."

"Our production rate went from 300 to 2000 per hour."

"Our floor loss went from 30% to 0."

FREE DEMONSTRATION

Quickest way to get complete understanding of the Setko System is to see it! You're welcome to visit the factory for a free demonstration...or ask for the free loan of the new 12 minute, 16mm color movie on Setko System. For details and free copy of Catalog 21, containing complete data on the Setko Hopper-Fed* Headless Set Screw System, mail coupon — or write direct.

1189-R

SET SCREW & MFG. CO.
266 Main St., Bartlett, Ill.

Please send your new Catalog 21. Also:

☐ Advise how and when I can see Setko Systems demonstrated.

☐ When can I borrow the new Setko movie for showing in my plant or office?

NAME _____

COMPANY _____
(Write address in margin of this page)

Circle 566 on Inquiry Card

Continental produces standard and special machines for our nation's largest industries

Shown here are a few of the trademarks of nationally known companies for which we have produced, in recent years, standard or special machinery of widely varied types.

Our 10-acre Birmingham plant contains the finest production facilities in the South. These include the area's largest machine shop, a complete fabricating and assembly plant and large Meehanite® foundry. Our engineers and craftsmen are skilled in working to exacting specifications and minute tolerances. Our standards of quality in workmanship and performance reflect our cumulative experience of 125 years.

We are equipped and ready to start on your job *now*. A call or a letter to any of our offices will bring a representative to discuss your requirements. Or further details without a personal call, if you prefer.

CG-5707

INDUSTRIAL DIVISION
CONTINENTAL GIN COMPANY
BIRMINGHAM, ALABAMA

CGC ATLANTA CLEVELAND DALLAS KNOXVILLE MEMPHIS MOBILE NEW YORK 17

the amount of expensive switching equipment in proportion to the lines served.

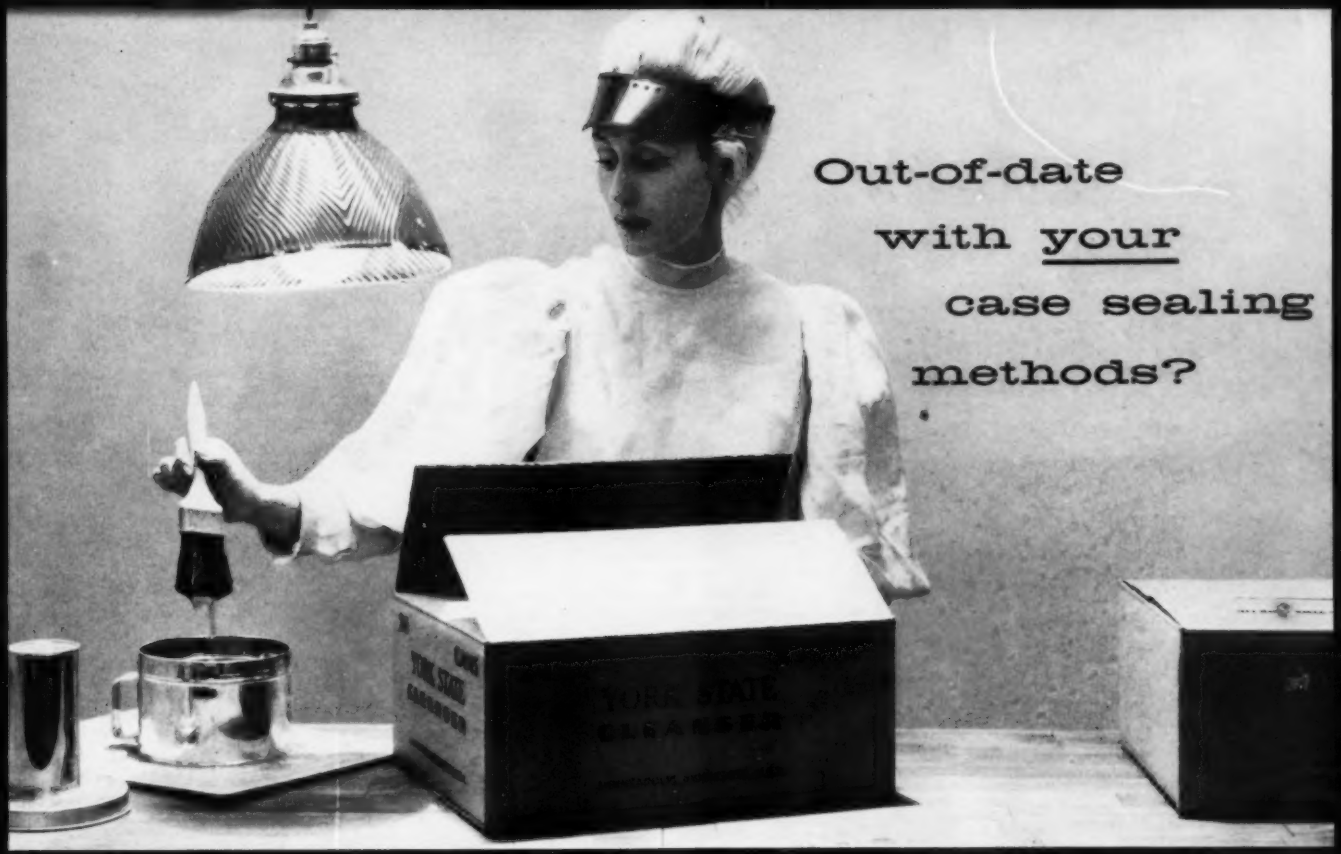
The Laboratore Central de Telecommunications, Paris, French research associate of IT&T, has demonstrated a fully electronic automatic telephone exchange constructed under contract from, and with the guidance of, the French Navy. In the 20-line exchange, the automatic interconnection among 20 subscribers and the supply of tones and ringing equipment are carried out by static electronic components; all mechanical movements and metallic contacts are eliminated.

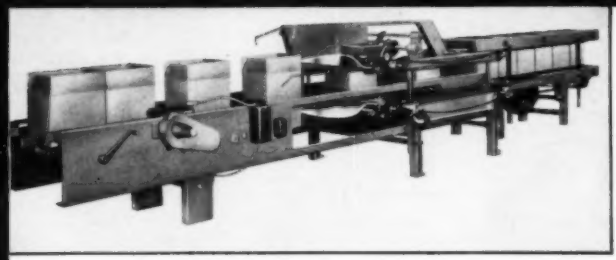
In addition to providing a more rugged and reliable system, the developments reduce considerably the amount of space needed for telephone exchange equipment (as much as 75 per cent), and facilitate the introduction of pushbutton systems to replace the present dial systems. The speed of operations in the static electronic system would allow the use of a pushbutton keyboard on which a seven-figure number could be presented in 3 or 4 seconds in lieu of the present 10 to 15 seconds required with the rotating dial.

Fast Card Handling System Matches Computer Speeds

VERSATILE inventory control system has been developed by ElectroData Div. of Burroughs Corp. for delivery to the Air Force. Entitled the Cardatron, the system enables conventional electromechanical punched card machines to work effectively with an electronic computer. This is accomplished by permitting the use of several card machines simultaneously with a single high speed computer. An average system, selling for approxmiately $130,000 consists of a single control unit with two input and two output units. As many as seven input or output units in any combination may be linked to various card handling devices through a single control. High speed magnetic drums in the Cardatron eliminate the need for most of the complicated plugboard wiring required by card machines. At the initial installation, the system will be used to check the accuracy of the

Circle 567 on Inquiry Card
Circle 568 on Inquiry Card→





PACKOMATIC FULLY-AUTOMATIC CASE SEALER

Loaded shipping containers IN, sealed cases OUT—and no operator needed! It aligns corrugated cases, positions flaps, glues, seals and discharges fully-automatically. Packomatic was first with this production-proved machine. It's available in a wide range of case sizes for installation on your present line. Semi-automatic, too.

J. L. FERGUSON CO. Joliet 2, Ill.

New York, Chicago, Cleveland, Boston, Tampa, Baltimore, Portland, Denver, Los Angeles, San Francisco, Seattle, New Orleans, Louisville, Kansas City and All Principal Canadian Cities.

PACKOMATIC machines include the Bale Sealer — Case Sealers — Opener-Loaders — Case Imprinters — Telescoping Volumetric Filler — Packer-Gluers. Units available, semi-automatic or fully-automatic depending on your needs.

Packomatic

T.M. Reg. U. S. Pat. Off.

equipment feeds, forms, positions, loads, seals, and imprints shipping containers automatically

Fully-automatic Packomatic Custom-Engineered machines go all the way—or any part of the way—with your packaging operations. Modernize your present line with a fully-automatic case sealer—or really put it into high gear with a Packomatic that feeds, forms, and positions shipping containers, end-loads them with cans or cartons at top speed, then discharges them sealed and imprinted, ready for shipment. Most important, only one part-time operator is needed for the whole operation. Labor costs are obviously reduced. End-loading techniques shrink paper board costs up to 28% and your whole output takes a sharp climb. Packomatics can save time and money. Let us show you.

Six 5-qt. cans or gallon cans in 20⅛" x 13⅜" x 9 13/16" case and 20¼" x 13¾" x 8¼"

Twelve 46 oz. cans in 21" x 13" x 7⅛" case

Twenty-four cartons in 12½" x 10⅝" x 8½" case

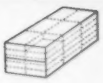
Eighteen 7 & 8 oz. cartons in 20" x 14⅛" x 8⅝" case

Sixty cigarette cartons
King Size: 17⅞" x 11½" x 22"
Regular: 14⅛" x 11½" x 22"

TYPICAL CASE LOADING PATTERNS FOR CANS AND CARTONS

Twenty-four 12 oz. cans in 16⅜" x 10⅛" x 5¾" case

Six No. 10 cans in 22⅛" x 17⅜" x 7⅛" case

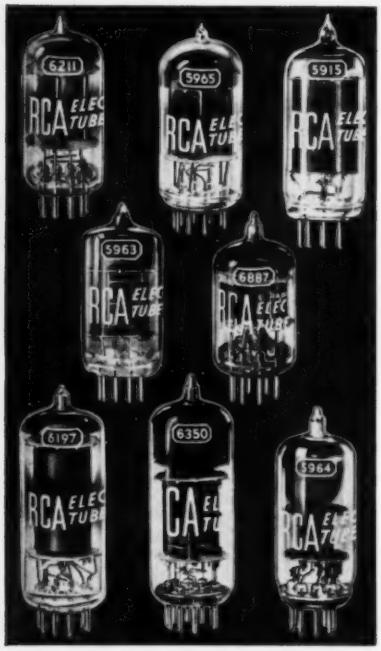


Thirty 1 lb. cartons in 16⅛" x 10⅛" x 7¼" case

Twenty-four cartons in 19½" x 10⅛" x 7" case

Forty-eight cartons in 22¾" x 23½" x 15⅞" case

RCA
COMPUTER TUBES
for
Sustained Reliability



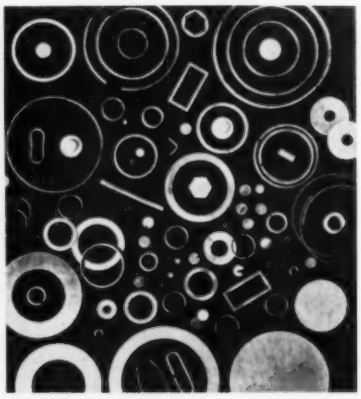
For high emission capabilities even after long periods of operation under cutoff conditions...for exceptional consistency of plate current during "On" time...for long, reliable service, specify RCA Computer Tubes. Quality performance is assured by: (1) rigid 100% microscopic inspection at every phase of tube manufacture, (2) factory tests under typical electronic computer operating conditions—including checks for cathode interface, interelectrode leakage, high-resistance, and intermittent shorts, and (3) tube life tests for conduction, standby operation, stability, and survival rate.

See your RCA Industrial Tube Distributor for the computer tube types you need. For prompt service, call him.

For free technical data on any of the following RCA Computer Tube types: 5915, 5963, 5964, 5965, 6197, 6211, 6350, 6887, write RCA Commercial Engineering, Section E 85Z, Harrison, New Jersey.

TUBES FOR INDUSTRY
Radio Corporation of America
® Tube Division Harrison, N. J.

Circle 569 on Inquiry Card



PREFORMED solder in various shapes is offered by Alpha Metals Inc. as an aid to automatic soldering. The various forms are available in different types of solder for various operations including flame, oven and induction heating. Preformed solder can cut many hours from production time and save materials in repetitive soldering processes.

records of the air base's $3 billion inventory stored on 300,000 punched cards and up-date the required records daily.

— MEETINGS AND EVENTS —

May 16-17—

American Institute of Industrial Engineers. Eighth Annual National Conference and Convention to be held Hotel Statler, New York City. Additional information may be obtained from D. J. Duffy, 44 W. 96th St., New York 25, N. Y.

May 20-23—

American Society of Mechanical Engineers. Second Design Conference and Design Engineering Show to be held New York Coliseum. Additional information may be obtained from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

May 22-24—

American Society for Quality Control. Eleventh Annual Convention and Exposition to be held Masonic Temple, Detroit. Additional information may be obtained from Hill & Knowlton, 323 Republic Bldg., Cleveland 15, O.

May 27-29—

Instrument Society of America. Third National Telemetering Conference to be held Hotel Cortez, El Paso, Tex. Additional information may be obtained from H. Pruss, Federal Electronics Corp., 1136 N. Las Palmas Ave., Los Angeles 38, Calif.

June 9-13—

American Society of Mechanical Engineers. Semi-Annual Meeting to be held Sheraton-Palace Hotel, San Francisco, Calif. Additional information may be obtained from society headquarters, 29 W. 39th St., New York 18, N. Y.

June 10-11—

Radio - Electronics - Television Manufacturers Association. Second symposium on Applied Reliability to be held Hotel Syracuse, Syracuse, N. Y. Additional information may be obtained from Engineering Dept., RETMA, 650 Salmon Tower, 11 W. 42nd St., New York 36, N. Y.

June 12-14—

Illinois Institute of Technology. Operations Research Conference to be held on university campus, Chicago. Additional information may be obtained from Conference Coordinator, Illinois Institute of Technology, 3300 S. Federal St., Chicago 16, Ill.

June 19-21—

Association for Computing Machinery. Twelfth Annual Meeting to be held University of Houston, Houston, Tex. Additional information may be obtained from association's 1957 Meeting Headquarters, University of Houston, Cullen Blvd., Houston 4, Tex.

AUTOMATION -

"Where'd you say that doorknob was again . . . ?"

Circle 570 on Inquiry Card→

setting
the pace
in modern

ECONOMATION

"ECONOmical
autoMATION"

sets
precedent . .

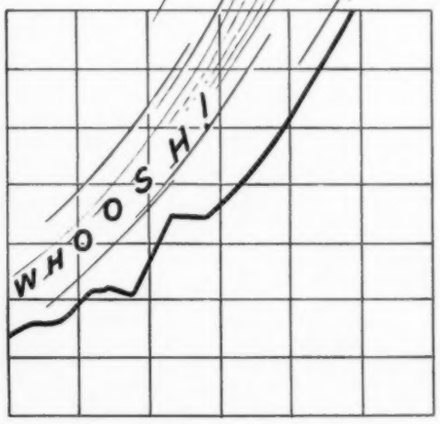
You have to move fast

to get the jump on today's expanding market

Industrial companies are spending more than $5½ million every twenty minutes for needed goods and services. In spending that much money, they move mighty fast. But *you* have to be even faster to sell to today's dynamic industrial market. Especially if you want to thoroughly cover your customers and prospects among the thousands of industrial companies that are spending this vast sum.

A sound, well-balanced advertising program can help your sales force make an immediate impact on this big market—the market that won't wait to be sold, because it can't wait to buy.

To keep ahead of this expanding market, put hard-hitting industrial advertising on the job. It will give you a greater return on your sales investment.

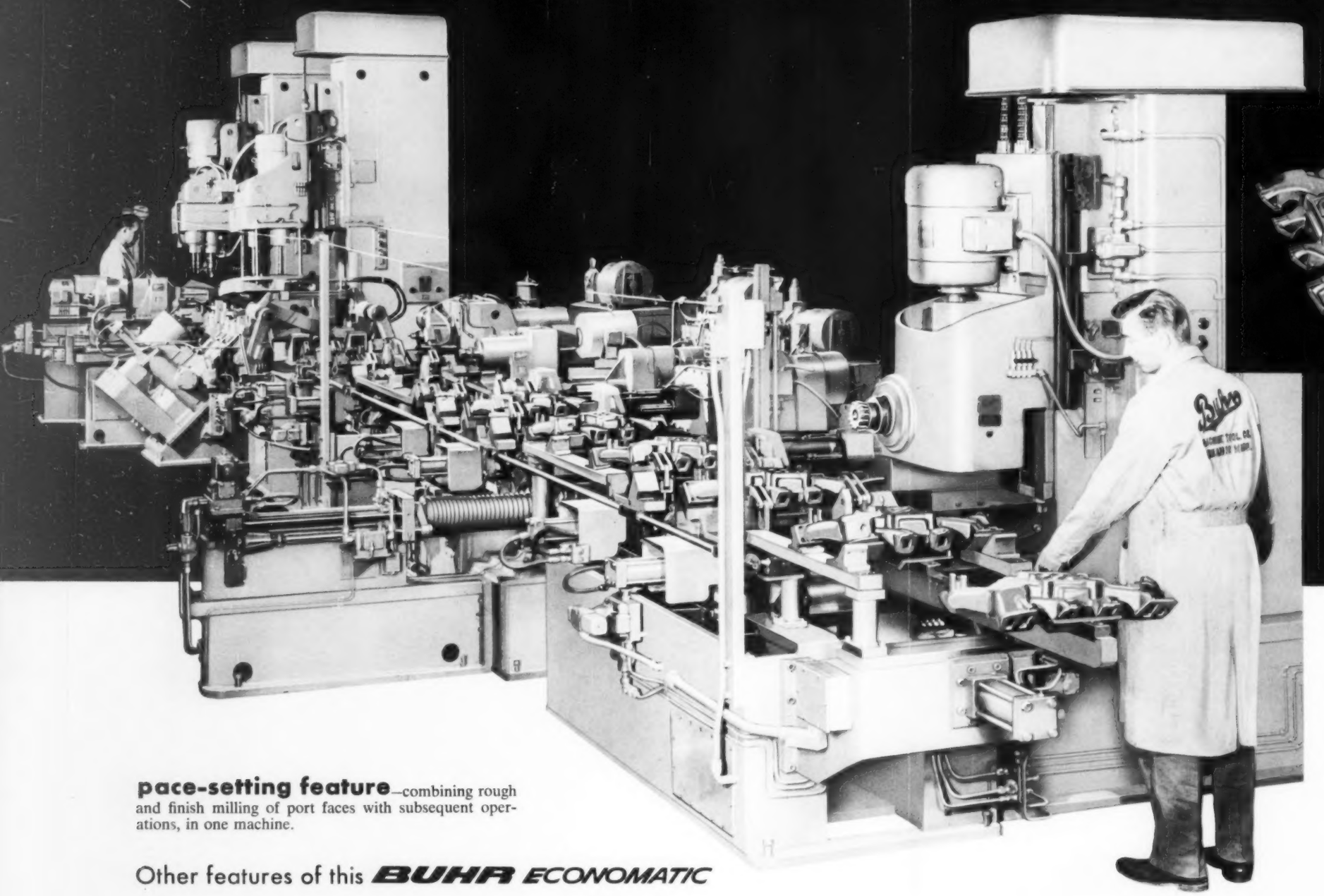


NATIONAL INDUSTRIAL ADVERTISERS ASSOCIATION, INC.

271 Madison Avenue, New York 16, N. Y.

An organization of over 4000 members engaged in the advertising and marketing of industrial products, with local chapters in ALBANY, BALTIMORE, BOSTON, BUFFALO, CHICAGO, CLEVELAND, COLUMBUS, DALLAS-FORT WORTH, DENVER, DETROIT, HAMILTON, ONT., HARTFORD, HOUSTON, INDIANAPOLIS, LOS ANGELES, MILWAUKEE, MINNEAPOLIS-ST. PAUL, MONTREAL, QUE., NEWARK, NEW YORK, PHILADELPHIA, PITTSBURGH, PORTLAND, ROCHESTER, ROCKFORD, ST. LOUIS, SAN FRANCISCO, TORONTO, ONT., YOUNGSTOWN.

BUHR ECONOMATIC sets precedent by . . .



pace-setting feature—combining rough and finish milling of port faces with subsequent operations, in one machine.

Other features of this BUHR ECONOMATIC

- parts may be banked between the two sections to minimize downtime during tool changes
- central graphic control panel
- exclusive Buhr detector system in main console
- J.I.C. Standards throughout
- special Buhr sectional-base construction to facilitate future part-changes
- standard and special parts interchangeable for ease of maintenance
- spindles arranged for pre-setting of cutting tools
- hardened and ground steel ways
- central mist-lubrication on all heads
- automatic lubrication of all moving parts
- automatic probing stations

BUHR MACHINE TOO

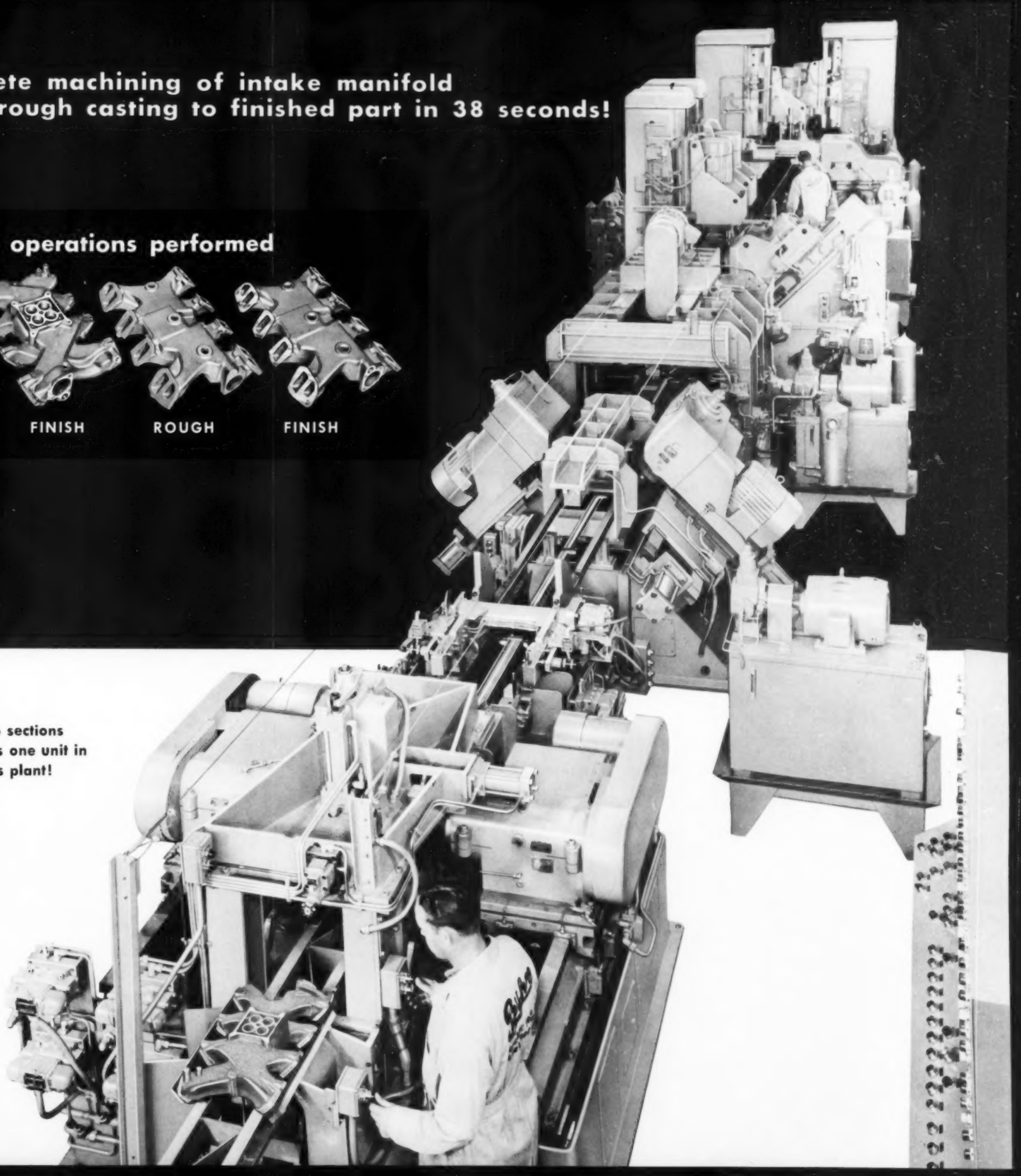
ANN ARBOR, MICHIGAN

Solidly Engineered • Precision Built • for World's Leading

nt by complete machining of intake manifold
. . . from rough casting to finished part in 38 seconds!

78 operations performed

ROUGH FINISH ROUGH FINISH



These two sections operate as one unit in customer's plant!

E TOOL CO.®

IGAN

rld's Leading Manufacturers

Askania Regulator Company NEWS

Automatic Controls for Edge Position and Thickness, Flow, Pressure, Ratio and Combustion

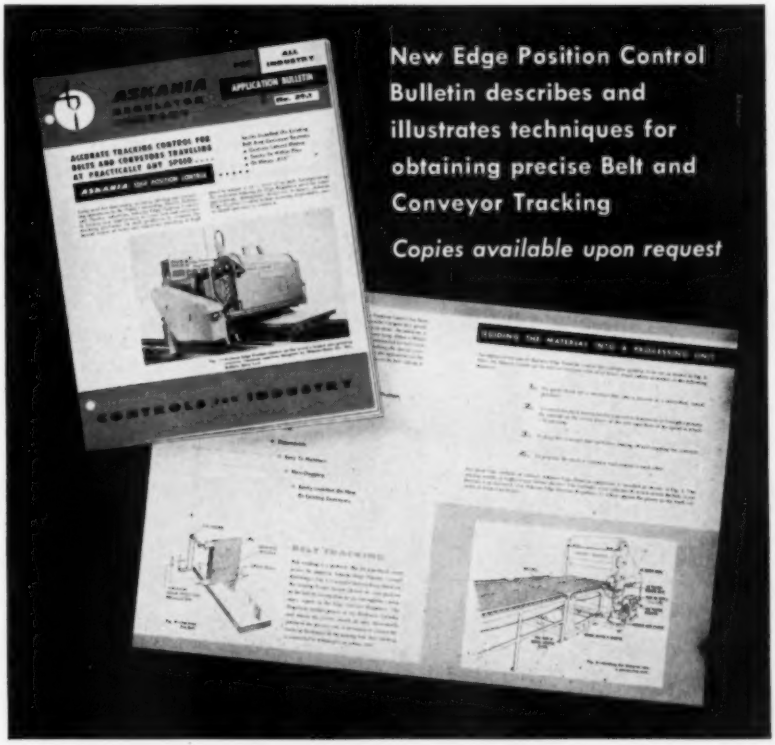
Bothered by LATERAL WEAVE of your Belts and Conveyors?

New information on Belt and Conveyor Tracking is provided in ASKANIA Regulator Application Bulletin #39.1. This bulletin is now available to anyone interested in:

1. **How to automatically control edge position when:**
   - A. Carrying material into a processing unit by means of a conveyor belt so as to deliver it at a specific lateral position into the unit.
   - B. Lateral weave of belt or conveyor must be eliminated so as to keep the material that it is carrying from falling off.
   - C. Tracking is a problem.
   - D. Lateral weave of belt or conveyor must be eliminated to permit maximum speed of operation...and/or prevent the belt itself from working off the roller.
2. **How to guide belt or conveyor at intermediate points or at other positions.**
3. WHAT makes the ASKANIA EDGE POSITION CONTROL the most effective device for eliminating lateral weave of even the highest speed belts and conveyors; easy to install and maintain; readily applicable to practically any belt or conveyor.

For example, the new bulletin diagrammatically illustrates:

- How to obtain precise tracking of high speed belts
- How to guide material into a processing unit
- How to position an intermediate steering roller to guide the belt in process



New Edge Position Control Bulletin describes and illustrates techniques for obtaining precise Belt and Conveyor Tracking

Copies available upon request

Sound, Practical Operation

Just check the Askania Edge Control advantages, listed below, which are completely described in bulletin No. 39.1. They explain why Askania Edge Position Controls provide consistently accurate belt tracking with a minimum of installation and maintenance. Askania Edge Position Controls are:

1. Non-contact—won't damage the edge of the belt or conveyor
2. Amazingly easy to install
3. Easily adaptable to *new* or *existing* machinery
4. Powerful—can position the heaviest rollers
5. Always dependable
6. Almost maintenance-free

Economy—Versatility

Bulletin No. 39.1 points out why and how these edge position controls

- Save you time and money
- Eliminate trial and error
- Permits higher operating speeds

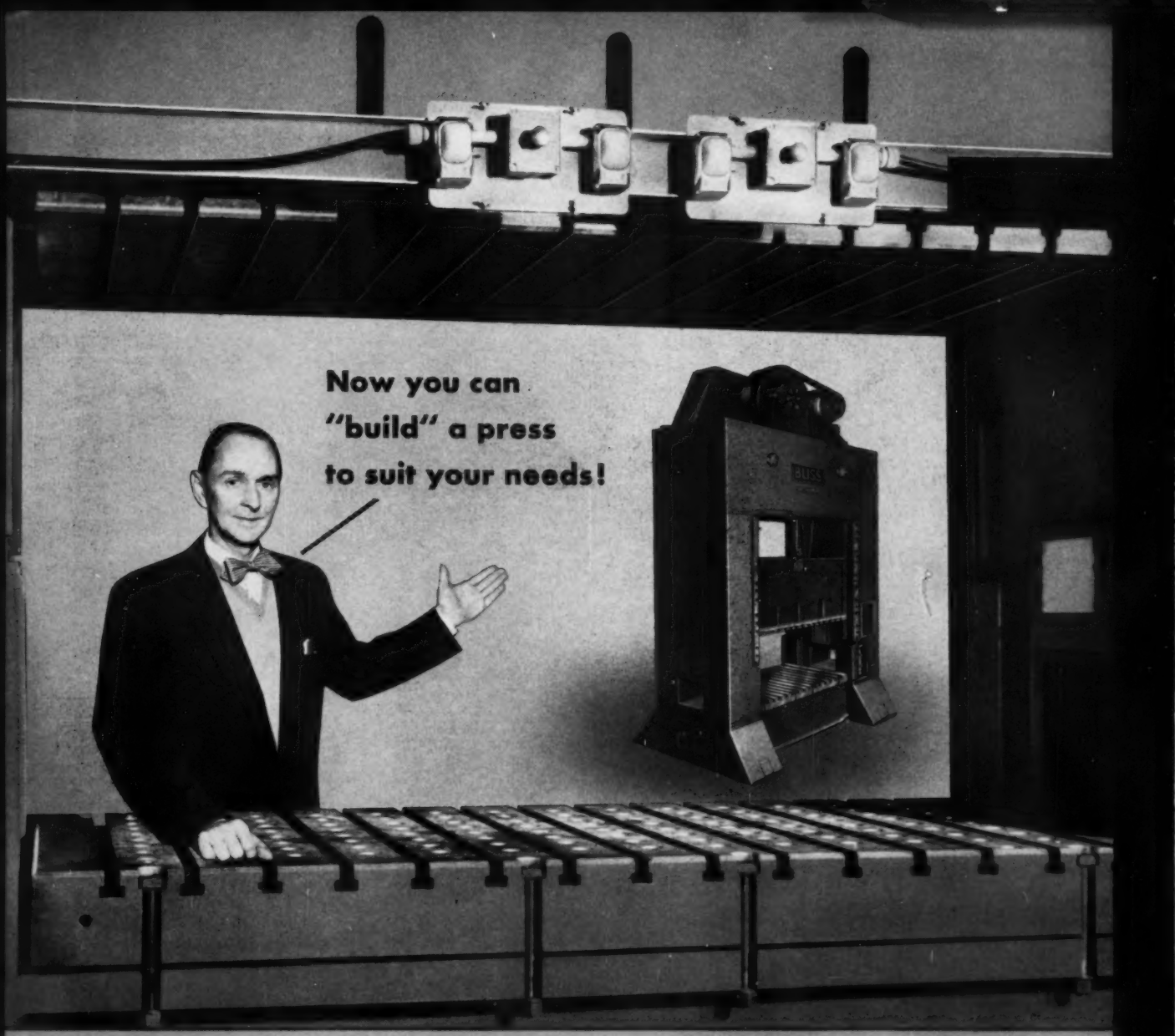
Answers your questions

You'll probably find just the answers you need to solve your own specific belt or conveyor tracking problems in Bulletin #39.1. SEND FOR YOUR COPY TODAY TO ASKANIA REGULATOR COMPANY, 244 E. Ontario St., Chicago 11.

ASKANIA REGULATOR COMPANY
"CONTROLS FOR INDUSTRY"
HYDRAULIC, ELECTRONIC CONTROLS & SERVOS, GENERAL SYSTEMS, ENGINEERING & COMPUTER SERVICE, VALVE ACTUATORS & CYLINDERS

A SUBSIDIARY OF GPE

Circle 571 on Inquiry Card



Why buy a press designed for someone else?

To these basic design advantages of the new Bliss SE-2 press . . .

- Enclosed design, all-welded construction, four-piece frame with tie rods drilled for electrical shrinking
- Recirculating oil system for gears, shafts, bearings, slide adjustment and *flywheel roller bearings*
- Bronze liners on the slideways running against lubrized cast iron gibs
- Motorized slide adjustment
- Counterbalance tanks
- JIC sizes
- Anti-friction bearings on *intermediate shaft* as well as on flywheel

. . . you can add any or all of these optional features

- Provision for automation controls and feeds
- Inbuilding
- Recirculating oil to the slide gibs
- Recirculating oil to the cushion gibs
- Automatic lubrication to counterbalances and cushion internals
- Air and electrical maintenance outlets
- Die lights
- Air control manifolds
- Special controls

A Bliss Chief Engineer tells...

How press buyers can "tailor" Bliss' new eccentric-gear design to fit their own needs!

"It's almost impossible to design a large press to please everyone. Yet that's exactly what we have tried to do with our new one point, two point and four point presses," says Chief Engineer Bill Staecker, of Bliss' Canton Plant.

"Here is how we approached the problem. Our field sales engineers worked for months with customers' operating executives and our press designers. On the one hand were the widely varying requirements of the big automated mass-production stamping plants; on the other, the needs of the job shops who use their presses for short runs. It was rare to find two sets of requirements alike.

"Flexible" design proves answer

"It was apparent that what was needed was a *flexible* basic design—a press that could have features added or subtracted to meet any user's needs without making him pay for features he didn't want. You can see how we have solved the problem by looking at the table of specifications at the left.

New drive cuts maintenance

"But...above and beyond the benefits of this basic design, these new Bliss presses have a 'unitized' drive mechanism based on a special *demountable* flywheel and outboard clutch. To get an idea of what this unitized design does for maintenance, consider these facts:

"Except for the main gears, nothing is built into the crown. The entire drive can be removed as a unit. Belts can be replaced without removing anything but the brake pins. And the entire clutch can be taken off simply by removing the brake bracket.

"You can see what this ease of disassembly and reassembly means when you compare it to maintenance steps on your present enclosed presses."

To sum up, when you buy one of these new presses, you pay for just what you need *and no more*. And you're buying the only fully-enclosed straight side press that is truly easy to maintain.

The new Bliss eccentric-gear presses are available in a full line of tonnages in both double and single geared models. For full details, write us today.

BLISS
SINCE 1857

100 years of making metals work for mankind

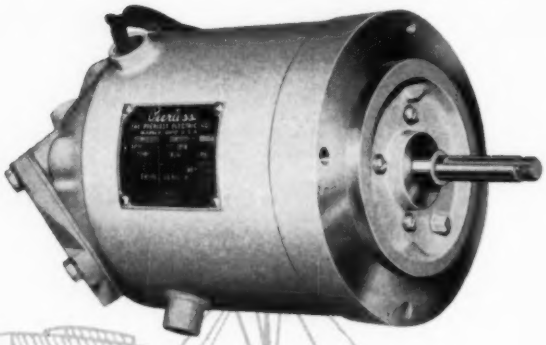
E. W. BLISS COMPANY, CANTON, OHIO
PRESSES, ROLLING MILLS, ROLLS, SPECIAL MACHINERY

U. S. Plants: Canton, Cleveland, Salem and Toledo, Ohio; Detroit and Hastings, Michigan; San Jose, California; Midland and Pittsburgh, Pa.; Branch Offices throughout the country.

Circle 572 on Inquiry Card

SHIPBOARD MOTORS

SPRAY-TIGHT SERVICE "A"



MARINE DUTY

BY Peerless

These Peerless motors meet all critical marine codes. Spray-tight Service "A" units withstand tremendous shock, high vibration levels and great temperature changes. To remove one costs almost as much as a new motor. They must be flawless.

The Peerless Marine Duty Motor is available in drip-proof, splash-proof, totally enclosed, spray-tight and water-tight construction from 1/2 HP to 30 HP.

Both Motors meet specifications of ABS, Mil-M- 17413 (DC), Mil-M-17060A (AC), AIEE 45 and U. S. Coast Guard. With standard or special mountings and features, they serve aboard vessels throughout the world. Give us your shipboard motor problem. We'll work with your engineers to produce the one motor that serves your needs best.

ELECTRIC MOTOR DIVISION

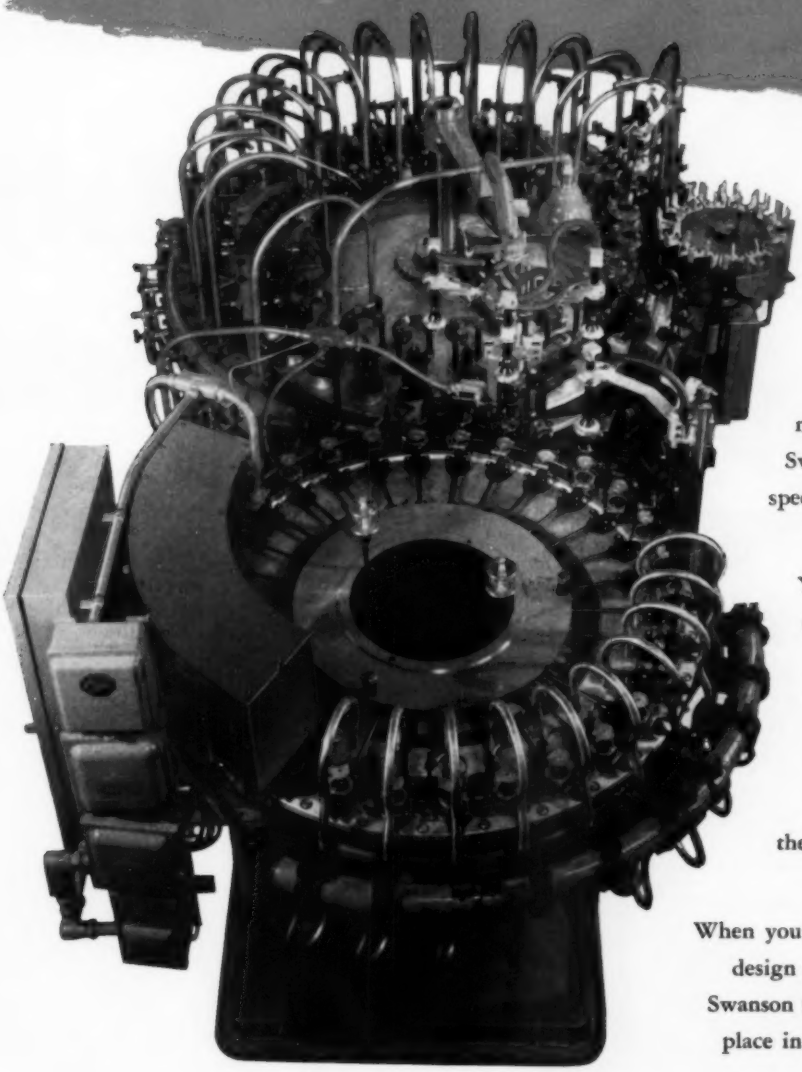
THE Peerless Electric® COMPANY

FANS · BLOWERS · MOTORS · ELECTRONIC EQUIPMENT

1512 W. MARKET ST. · WARREN, OHIO

Circle 573 on Inquiry Card

This is NOT a single purpose machine!



Automatic sealing and exhausting machine for incandescent lamp bulbs

This is a special automatic machine, designed and built by Swanson-Erie for one customer's specific needs. Yet it accomplishes more than a single purpose.

Years ago we took the common chassis elements from this and many other machines of our design, and incorporated their best features into a line of Swanson Standard Indexing Machine Chassis that fill the requirements for most special purpose machines.

When you investigate the full economic, design and maintenance advantages of Swanson units, you will appreciate their place in your equipment specifications.

SEC

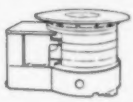
SINCE 1919

SWANSON-ERIE CORPORATION

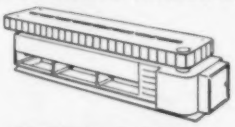
814 EAST EIGHTH ST., ERIE, PA.

OVER 200 STANDARD MODELS OF INDEXING MACHINE CHASSIS

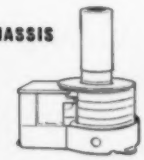
Series B & C Turret Index Models—for medium and light applications.



Series H Turret Index Models—for heavy duty applications.



Series L Auto-Trac Straight Line Indexing Chassis—for automatic or semi-automatic assembly and processing operations.



Series N Turret Index Models—for heavy duty applications with center column tool mounting.

ENGINEERS AND BUILDERS OF AUTOMATIC AND SPECIAL PURPOSE MACHINES

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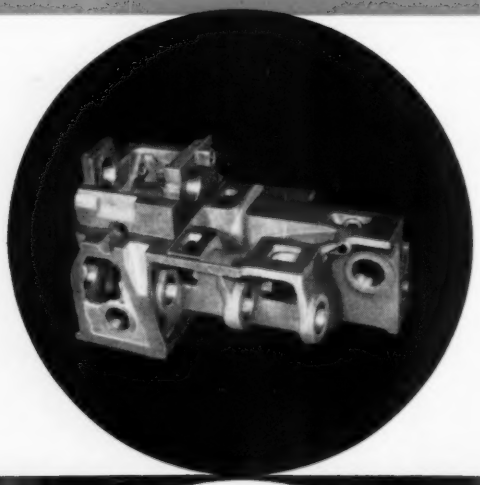


At Brown & Sharpe

Natcos Help From

At Brown & Sharpe, a 22-spindle Natco 3-way Machine handles finished drilling, boring and reaming on "00" screw machine beds

NATCO

Slash In-Process Time 16 Weeks to One Week

On Automatic Screw Machine Beds

Even on precise machine tool parts, traditionally handled on a "job-shop" basis, Brown & Sharpe gained great advantage by installing an automatic line. Prominent in the line are two Natcos, engineered and tooled to handle all drilling, boring and reaming on either the No. 00 or No. 2 automatic screw machine beds.

One Natco does all roughing—the second handles finishing. Total of 62 operations. Each Natco is tooled to process two parts at once—tooling is interchangeable to accommodate either sized bed.

Extreme machine tool accuracy must be maintained throughout. In one operation the Natco drills through five walls, holding centers parallel to the locating surface within .0015" for the full 42" distance. In another case, Natco engineering devised a tooling leaf that automatically drops through a core in the part, providing internal boring bar support.

Natcos make sense even on "job-shop" jobs. Call in a Natco Field Engineer—he can quickly tell you whether a Natco can be a cost-saver on your next job.

National Automatic Tool Company, Inc.

Richmond, Indiana ***Multi-spindle drilling, boring, and tapping machines. Special machines for automatic production. Call Natco Offices in Chicago, Detroit, New York, Buffalo, Boston, Philadelphia, Cleveland, Los Angeles; distributors in other cities.***

Circle 575 on Inquiry Card

Fast, uniform heat dialed to your exact need with CHROMALOX® Electric Far-Infrared

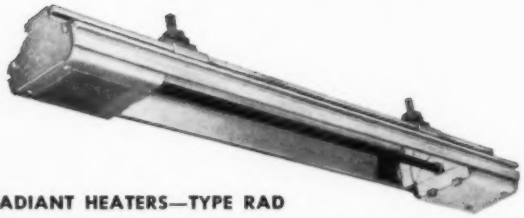
Here are four quickly available, easily installed ways to end production delays, irregular product quality and other common problems caused by inadequate heat sources. With Chromalox Electric Far-Infrared, you get uniformly distributed heat at the right temperature for the work. No more stand-by losses, leaking lines, smoke, fumes or flames. It's cooler and cleaner for your workers, too.

Chromalox Electric Far-Infrared radiation is absorbed uniformly by practically all colors, even by transparent materials. Elements are self-cleaning and maintenance costs are a bare minimum. All-metal heaters are practically indestructible. With no need for stand-by heat and since heat is generated where used, all energy is utilized.

To get more information, call your Chromalox Representative or write us direct for the Bulletins listed. In addition, if you will tell us your problem, we will send you a case history of an identical or similar application.

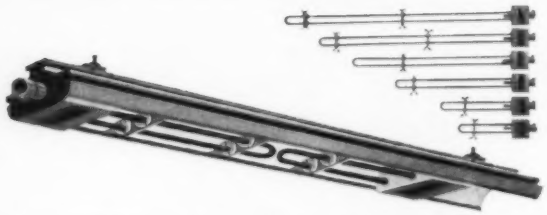
With Chromalox Electric Far-Infrared, you benefit in all these operations:

Annealing • Calendering • Curing Degreasing • Dehydrating • Drying Embossing • Food processing • Forming Fusing • Heat sealing • Laminating Molding • Paint baking • Planishing Polishing • Resin finishing • Setting coatings • Shrink fitting • Weld preheating.



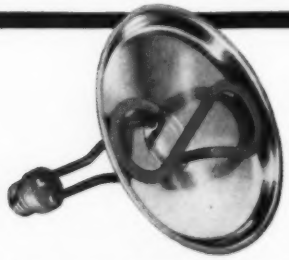
RADIANT HEATERS—TYPE RAD

For single assembly or in banks. Two bolts in sliding clamps facilitate mounting; two wires to connect. Six standard lengths, 14 standard wattages. Housing is rigid extruded aluminum with brightly polished parabolic non-oxidizing reflector. Write for Bulletin CS-604.



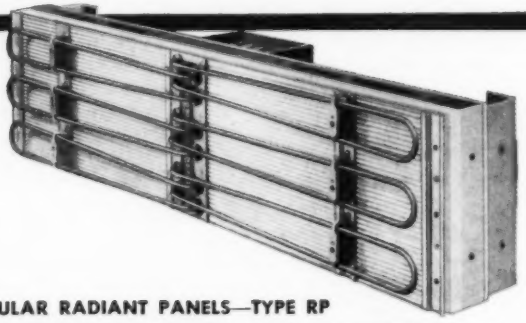
ADJUSTABLE AREA RADIANT HEATERS—TYPE U-RAD

Lets you match heat area to work area. Choose one basic housing to match your largest work. Into this housing install any of 6 different heaters to get up to 27 heated lengths as job sizes change. Bulletin CS-607



METARAY® LAMP REPLACERS—TYPE FRB

Now any infra-red reflector bank can be equipped with glassless, glareless, self-cleaning Metaray elements. Radiation is spread more uniformly from the larger element configuration. Write for Bulletin L-1104.



MODULAR RADIANT PANELS—TYPE RP

A high-intensity heat source in four standard sizes. Modular panels completely factory assembled with built-in continuous bus, reflector, insulation, frame and mounting. Lets you tailor heat source exactly to process requirements. Write for Bulletin CS-606.

THE RIGHT HEAT, EASILY DUPLICATED AT THE TURN OF A DIAL

Inexpensive, automatic input controllers provide accurate temperatures. As required by different work, heater input can be set anywhere from 4 to 100% of capacity. Better control, combined with better distribution, give more uniform product quality and higher production.

CHROMALOX — FIRST NAME IN ELECTRIC HEAT

Edwin L. Wiegand Company

7850 Thomas Boulevard • Pittsburgh 8, Pa.

C-2181

Circle 576 on Inquiry Card

Circle 683 on Inquiry Card→

Conveyors Modernize Production Flow...

DOUBLE

Station Wagon Volume

The Ionia Manufacturing Company, Division of the Mitchell-Bentley Corp., Ionia, Michigan utilized more than 4½ miles of Webb conveyors in converting their five-floor plant into a "one-floor" assembly line. They manufacture station wagon bodies for two G.M. and one Ford Division. Forty-three Webb conveyors of four different types have transposed this plant into the acme of modern manufacturing . . . and doubled production volume.

The Jervis B. Webb Company manufactures all types of conveyors for automatic handling of any material from hairpins to raw steel. For more information on how Webb conveyors can improve your materials handling and reduce production costs, contact any Webb District Office or write direct.

The large illustration above shows a location on the third floor where a Webb Floor Type Conveyor carrying station wagon bodies is joined by a Webb Trolley Conveyor handling seat assemblies and other interior parts.

The photograph above is another view of the Trolley Conveyor coming up from the second floor . . . this time loaded with sub-assemblies for the storage area.

More details on reverse side

JERVIS B. WEBB COMPANY

SPECIALISTS IN CUSTOM CONVEYOR SYSTEMS

8939 ALPINE AVENUE • DETROIT 4, MICHIGAN

FACTORIES: DETROIT • LOS ANGELES • ATLANTA • HAMILTON, ONTARIO, CANADA • ENGLAND • FRANCE • BELGIUM • AUSTRALIA

Conveyors Modernize Production Flow... DOUBLE Station Wagon Volume

Stampings are carried to third floor from railroad receiving dock by a Webb 6" overhead trolley conveyor (1) bisecting the building. Parts go into storage (2) for controlled feeding to conveyor system. Trolley Conveyor (3) with carriers coded for scheduled parts are loaded from storage by stock handlers. In production area, small parts are removed and placed in fixtures (4) and welded into sub-assemblies. The same conveyor carries sub-assemblies to side panel assembly power and free conveyor (5) where complete side panel assemblies are welded. They are then transferred from these conveyors, placed on another trolley conveyor (6) and transported to fourth floor.

Here (7) side panel assemblies, roof tops and floor decks are positioned into body jig and gun welded. Bodies travel automatically through all phases of assembly and finishing . . . Bonderizing (8), prime (9), bake (10), wet sand (11), 1st finish coat (12), 2nd finish coat (13), polish (14) . . . On the third floor, hardware (15) and interiors are installed (16). After final inspection (17) a Webb Floor Conveyor feeds bodies to a shipping area. Here eight storage lines hold four complete truck loads ready for shipment. At this point a Webb automatic positioning body elevator loads haulaway trucks in minutes, completing the production cycle.

Ionia Manufacturing Company has good reason to be proud of their plant. With efficient conveyorizing, they have solved almost insurmountable production problems. Webb engineers, working with Ionia plant engineers, created a well organized, coordinated production flow.

JERVIS B. WEBB COMPANY

SPECIALISTS IN CUSTOM CONVEYOR SYSTEMS

DETROIT 4, MICHIGAN

IF YOUR PROBLEM IS MODERNIZING PRODUCTION FLOW . . . CALL IN A WEBB ENGINEER

IBM growth promoted this man

Computer Programmer: Before his recent promotion, this man was a research programmer working with a giant IBM 704 electronic computer. He was engaged in the preparation of research problems of an engineering, scientific, business, and industrial nature for machine solution. His work entailed advanced diagnostic and application program development, including the modification of existing systems and proposed new systems. "This work has the same fascination as a game of chess," he'll tell you, "and the variety of constant challenges makes it absolutely absorbing!"

Could you handle his responsibilities?

Jobs like these continually open up at IBM—due to rapid expansion. If you are an engineer or scientist—or have equivalent experience—you may qualify for such a position. Innumerable opportunities exist in:

- Computer systems planning
- Computer systems testing
- Electronic circuit design and packaging
- Electrostatic phenomena
- Manufacturing process control
- Numerical analysis and programming
- Photo and magnetic device memory
- Real time systems engineering
- Semi-conductor research, development and manufacturing
- Test equipment design

For the facts about an engineering career with IBM, just write, outlining background and interests, to:

R. A. Whitehorne
Mgr. of Engineering Recruitment, Department 9705
International Business Machines Corporation
590 Madison Avenue, New York 22, N.Y.

The electronic computer field offers one of the best ground-floor opportunities today. Economic experts rank it with automation and nucleonics in growth potential. Sales at IBM, the recognized leader in this fast-growing field, have doubled, on the average, every five years since 1930. Engineering laboratory personnel has quintupled in the past five years. IBM's excellent salaries and employee-benefit programs are instrumental in achieving an employee turnover rate far below the national average.

Where would you like to work for IBM?

IBM plants and laboratories are located in: Endicott, Kingston, New York City, Owego, Poughkeepsie, N. Y.; Burlington, Vt.; San Jose, Calif.; Washington, D. C.; Greencastle, Ind.; Lexington, Ky.; Rochester, Minn.; Sherman, Texas.

IBM DATA PROCESSING

DATA PROCESSING • ELECTRIC TYPEWRITERS • MILITARY PRODUCTS • SPECIAL ENGINEERING PRODUCTS • TIME EQUIPMENT

Next Page Circle 578→

Circle 577 on Inquiry Card

"HARTFORD SPECIAL"

COMPLETELY TOOLED MACHINES
ready to produce on your floor

Automatic production and parts processing machinery is our business. 45 years of designing and building experience go into every machine tool that leaves our plant.

The dependable volume and consistent economy of Hartford machines is the direct result of our development and use of standard, production tested machine components.

"HARTFORD" Automatic Nine Station 45 Spindle Indexing Machine. Drills, Chamfers, Probes and Reams. Machine features automatic clamp, unclamp and part ejection.

AUTOMATIC EQUIPMENT

For plants with long-run high production jobs the answer is Hartford's automated production machines . . . for plants requiring diversified short-run production, the answer is Hartford's complete range of "building blocks", standard machine components which can be assembled on your floor to fit the job. Consult Hartford engineers for both — better products at lower cost through better methods will be the result.

STANDARD MACHINE COMPONENTS

ready for assembly into production machines on your floor

QUILL TYPE AIR HYDRAULIC DRILL UNITS

QUILL TYPE LEAD SCREW TAPPING UNITS

QUILL TYPE CAM UNITS

MACHINE BASES

WAY TYPE HYDRAULIC FEED UNITS

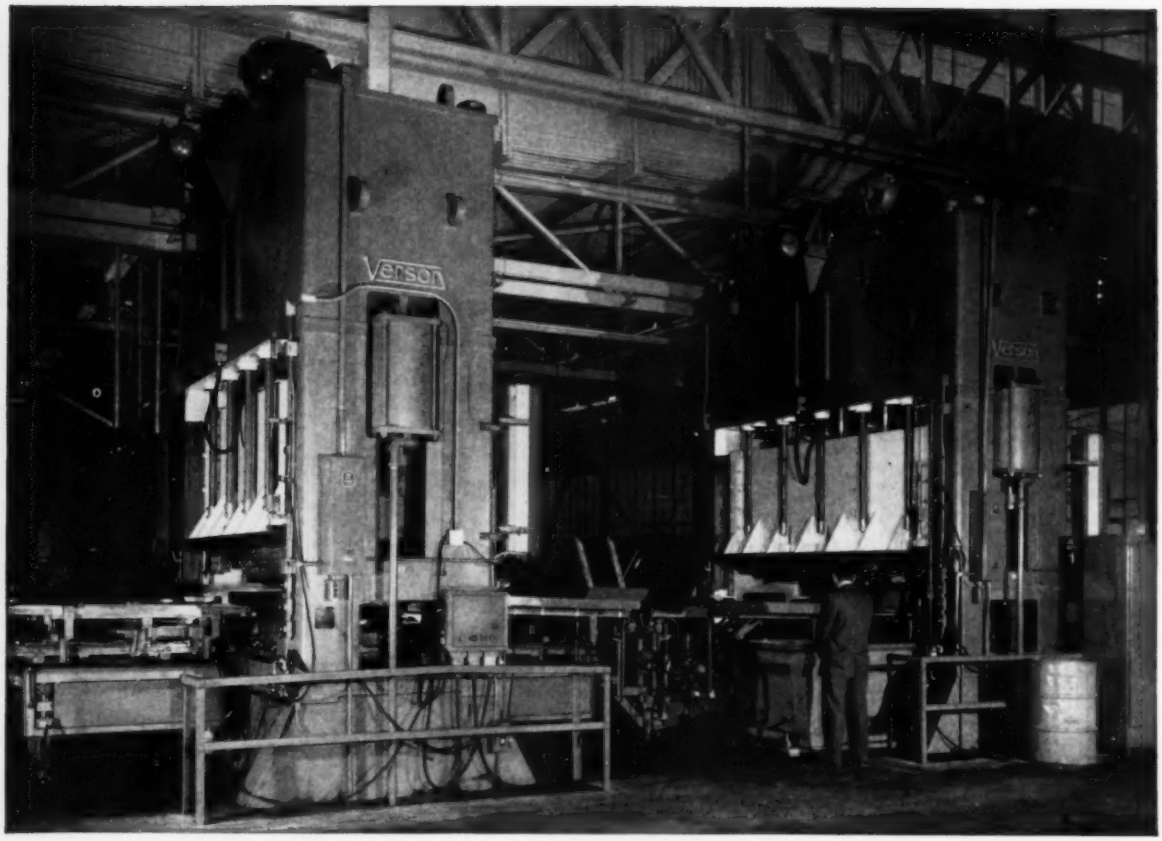
AUTOMATIC INDEX TABLES

"Hartford" double end drilling machine assembled completely from standard components — Drill Units, Base and Cabinet.

"HARTFORD" ALSO BUILDS AUTOMATIC THREAD ROLLING MACHINES AND THE WORLD FAMOUS SUPER-SPACER

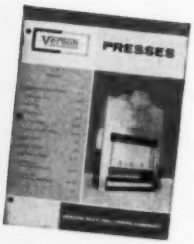
HARTFORD *Special*

MACHINE TOOL DIVISION
THE HARTFORD SPECIAL MACHINERY CO.
2855 HOMESTEAD AVE., HARTFORD 12, CONN.



Two 400 ton Verson Presses

perform as one production unit to manufacture automatic dryer bodies



Catalog G-56 describes the entire Verson line and gives design details and specifications. Write for your copy, today.

The two 400 ton Verson eccentric presses shown above, integrated with automatic handling equipment and controlled by one operator, perform as a single production unit in the manufacture of automatic clothes dryer bodies for a leading appliance manufacturer. The press on the left blanks and forms the dryer body and draws the front face with door opening. The parts then move automatically to the press on the right for flanging and punching operations. Speed is 14 strokes per minute.

Verson presses are engineered to become an integral part of the production process in which they are used. If you make stampings of any kind, this approach to your problems can mean big savings. Send an outline of your requirements today and put real production know-how to work for *you!*

A Verson Press for every job from 60 tons up.

TRADE Verson MARK

ORIGINATORS AND PIONEERS OF ALLSTEEL STAMPING PRESS CONSTRUCTION

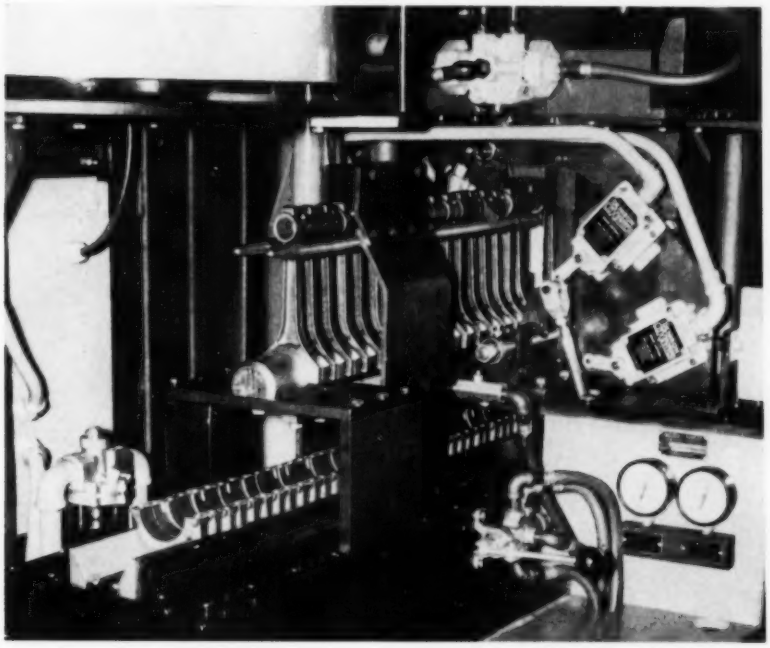
VERSON ALLSTEEL PRESS CO.

9322 S. KENWOOD AVENUE, CHICAGO 19, ILLINOIS • 8300 S. CENTRAL EXPRESSWAY, DALLAS, TEXAS

MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES • TRANSMAT PRESSES • TOOLING • DIE CUSHIONS • VERSON-WHEELON HYDRAULIC PRESSES

Circle 579 on Inquiry Card

By JAMES C. KEEBLER
Associate Editor



Loading end of an assembly machine designed and built by Ingersoll Rand. "Lift-and-Carry" conveyor moves preoriented connecting rods and caps into the first station of a positive index mechanism which transports parts in pairs to screw feeding, screw pressing, cap assembly, and nut running stations. Screws are fed from a vibrating bowl and nuts are fed from an elevator-hopper.

Quality Assembly

PLYING this trade as an observer and writer of things automated and automotive sometimes takes us to shores distant from Detroit. The Spring National Production Meeting and Forum of the SAE had a crowd of automotive automaters shuffled into Buffalo to swap ideas.

Put It Together

Of high current interest to automakers is the development and use of automatic assembly machines. AC Spark Plug Div.'s Glen R. Fitzgerald (formerly director of the Process Development Section at GM's Tech Center), in speaking about process improvements being developed through manufacturing research, reveals the status quo by saying:

"In General Motors, the largest single group in the direct labor force is employed on assembly work. This is an area that has been traditionally manual and offers great potential for continual improvement through the application of methods engineering. Beyond this point, however, a great deal is being accomplished in the development of mechanical assembly equipment. One GM division alone has over 100 semi-automatic and automatic assembly machines in operation at the present time."

What Have You Got?

One thing that the automakers see on automated assembly machines is what appears to them to be high price tags. Yet like other automatic operations they pin the decision on the question of economics. The procedures in use to figure payoff vary with the corporation doing the figuring, but there is agreement on the categories of items to be considered. Top brass has to set up its own book of Hoyle on what types of equipment fit in each of its accounting and depreciation classifications and what payoff period applies to each class.

Then the guy who's fathering this idea takes his sharpest pencil and considers all the costs. These can be broken down into three main groups: (1) Cost to develop the process and equipment, (2) cost to build the equipment, and (3) cost to run the process with this equipment.

Development costs include engineering, models and mockups, and pilot lot debugging; build costs involve not only ordinary fabrication but allowances for overtime on tight delivery schedules; cost to run includes material, labor, and all overhead burdens such as power, downtime, maintenance charges, and supervision.

For existing jobs this study results in a comparison between the present method and the suggested improvement. For new jobs this is a choice between proposed alternatives.

Experience Is The Best

As more experience is gained in the field, the cost picture continues to change. Once your feet are wet you're ready to get in and swim. After developing some assembly machines an engineering organization builds up know-how that reduces the cost of subsequent engineering projects to devise other assembly machines. As this type of know-how is accumulated we can expect to see more standard assembly machine components

(*Continued on Page* 50)

Find out whether this new machine will bore your parts 3 to 8 times faster!

Parts with long holes . . . or identical parts,

The new LeBlond-Carlstedt Rapid Borers solid bore, trepan or counterbore holes 3 to 8 times faster than by the conventional D-bit method! *Hole capacity from 5/16" to 4-1/4" diameter.* Basically, the Rapid Borer is suited to work that is symmetrical for balance in rotation—round, square, octagonal, tapered or stepped. A wide variety of hole diameters and depths as well as work sizes can be handled.

The Rapid Borer was developed expressly to accommodate revolutionary new tooling which cuts at very high speed with good accuracy and finish. Cutting oil at high pressure is forced between the boring bar and hole wall forming a continuous bearing. It flushes back through a hole in the boring head and bar, carrying away the chips as it goes. Chip form is controlled both by tool angles and proper feed and speed combinations; thus tool faces are kept clean and chip passage clear. Cutter design produces balanced cutting pressures thereby controlling concentricity.

This new tooling requires a machine with the following characteristics, all of which are incorporated in the LeBlond Rapid Borer design—High spindle horsepower; Ample rigidity throughout; Complete absence of vibration at all speeds; Infinitely-variable feeds, independent of speeds, while running under load; Final drive to spindle through belts; Large volume of cutting oil. Available in 3 sizes, No. 15, No. 30 and No. 60.

Tell us about the holes you'd like to produce faster. Large holes or small. If the Rapid Borer can handle the job, we'll show you how to produce them faster than ever before. Other equipment available for holes larger than 4¼".

THE R. K. LEBLOND MACHINE TOOL COMPANY
Dept. P. Cincinnati 8, Ohio

Gentlemen:
We want to know if your Rapid Borer really will bore our part 3 to 8 times faster. Here's a description of the job.

*Size of hole to be bored*_____

*Length of hole to be bored*_____

*Annual production of parts*_____

*Material and Hardness*_____

Conformation of part and dimensions (send sketch or print)

Name_____

Title_____

Company_____

Address_____

City_____ State_____

bored as one piece, then cut apart.

These tremendous production savings can be yours!

Rapid Borer Time: 5.2 minutes
D-Bit Time (old method): 41.5 minutes
Hole diameter . . . 1-17/32"
Hole length . . . 31¼"
Part material . . . C-1141 Hot Rolled 187 Brinell
Part outside diameter . . . 2.450" at small end, 2.710" at large end.
Feed rate (solid bore) . . . 6" per minute

Rapid Borer Time: 17.75 minutes
D-Bit Time (old method): 86 minutes
Hole diameter . . . 2-3/16" Core diameter . . . .852"
Hole length . . . 53¾"
Part material . . . 4140 Forging 200 Brinell
Part outside diameter . . . 3.455" at small end, 4.425" at large end.
Feed rate (trepanning) . . . 3" per minute

For complete information write for Bulletin LC 501A

THE R.K.LeBLOND MACHINE TOOL COMPANY

Cincinnati 8, Ohio

World's Largest Builder of a Complete Line of Lathes for more than 70 years

LeBLOND of Cincinnati

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(*Continued from Page* 47)

or building blocks which will reduce build cost of this type equipment. The more different types of assembly jobs that are run by a given shop the more they will learn about techniques to keep downtime and maintenance expenses to a minimum.

He's Making A List

This cost saving knowledge is now wrapped up in the heads of those individuals who have already done some swimming in this pond. Harry Adams of Chrysler's staff master mechanics department revealed that they are surveying all potential suppliers of automatic assembly machines to list what they've made and who is using it. Of interest in this survey is whether or not the men who engineered the job are still with the supplier. After all a man takes his experience with him wherever he goes.

Checking It

Since assembly machines have big price tags, no one can afford to play Santa Claus and so the idea is to check the list and actually see the equipment in operation. The importance of talent on the team cannot be overemphasized.

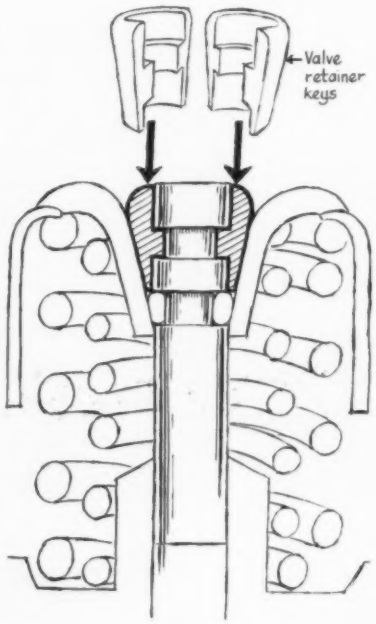
R. L. Dustman, productive equipment manager of the Chevrolet Central Office, underscores the value of ingenuity in this business by indicating that automakers are too accustomed to million-dollar lines, having seen the clever gimmicker in a small shop do for several hundred dollars what the big boys can do for the same number of thousand dollars.

Interest in this type of automated equipment is reflected across the industry. Central staff appointments at Ford show that they are organizing for assembly too. In announcing additional duties for D. S. Harder, Ford also announced the appointment of Harold R. Foss as director of the newly created assembly operations office on Harder's staff.

Aside from the cost considerations of assembly machines the automakers find that this equipment has a close link to their quality situation.

Good, Good, Good

Orienting and feeding of parts requires chutes, tracks, escapements and loaders that confine the part where you want it and do not jam in so doing. The most convenient surfaces for locating and stopping workpieces in automated assembly machines are not always the same surfaces that are held to close tolerances in the functional design of the product. With this condition existing, automatic assembly operations can place more stringent quality requirements on workpiece dimensions than have been experienced under manual assembly techniques.



Automatic assembly of valve retainer keys for an automobile engine presents a complex orienting and feeding problem. Production operations of this nature can place more stringent quality requirements on workpiece dimensions than are specified for the functional design of the product.

In this regard automotive parts suppliers have experienced situations where a 99.9 per cent acceptable quality level was no longer acceptable because parts jammed in the assembly machine.

This type of trouble can be whipped in various ways. One technique is to integrate a gaging station into the parts feeder of the assembly machine. Thus, the processing engineer does his own weeding in his own back yard. Only parts acceptable on the critical dimensions are processed through the feeder into the escapements.

On some critical machines this technique has been found lacking, and duplicate stations are provided for the critical operation. In the event of trouble on the regular station the machine shuts down and signals the operator. The necessary switching is accomplished to short-circuit the jammed station and operate on the alternate station while the jam is being cleared. This method has been employed in the case of valve retainer keys which would otherwise shut down a large cylinder head assembly machine.

Other circumstances suggest other solutions. Where one assembly machine of a given type is required to fill production schedules, one inspection machine may be employed to provide parts for a group of identical assembly machines rather than integrate the inspection station into the assembly machine.

Whipping the Problems

Examples have been cited where the problem was whipped by conference with the parts supplier who had been unaware of these newly created quality specifications. These experiences emphasize the need for close co-operation between the product designer, the processing engineer, the quality engineer and any parts vendors involved in the assembly operations. Each of these men must contribute his talents to the teamwork if success of the automated assembly project is to be achieved.

With better quality parts going into automobile assemblies, automakers can expect better quality assemblies. This fact must be accounted for in totaling the cost scores so that more automated assembly equipment will be ordered and more experience can be gained to enable still further cost reductions.

(Advertisement)

MORE EFFICIENT DESIGN, IMPORTANT SAVINGS, SIMPLIFIED ASSEMBLY, BETTER APPEARANCE

These are some of the many benefits reported by Design Engineers who have adopted TRU-LAY PUSH-PULLS for remote control operations on literally hundreds of products

Here are typical comments recently received from equipment manufacturers whose machines or implements are equipped with these accurate and dependable remote controls:

Saves Time, Labor and Material
"The use of your flexible Push-Pulls saves us a great deal of time, labor and material. The old linkages frequently required much planning in both engineering and shop which is not required now. On some of our equipment we use Push-Pulls from 10 to 30 feet in length. They operate clutch controls on the Main Power Unit, Feed Conveyors and Delivery Conveyors."

Greater Flexibility of Design
"The principal advantage of Tru-Lay Push-Pulls in our application is that they permit flexibility in locating the control valve in relation to the operator's position."

Cost Less to Install
"Tru-Lay Push-Pulls are easier and less expensive to install than linkages for remote control of power take-off, brake and clutch. Better appearance, too."

Simple and Neat
"For several models of farm tractors, we selected your controls for their simplicity and neatness of application as governor controls."

Solution to Tough Problem
"Can be installed where straight rods are impossible . . . for Remote Control of transmissions, brakes and clutches."

Eliminates Maintenance
"Simple operation and elimination of maintenance problem are the major advantages in using your Push-Pulls."

Reduces Number of Parts
"Your Push-Pulls have eliminated links, radius rods and other lost-motion devices for remote control of hydraulic valves."

Provide ACCURATE Control
"Tru-Lay Push-Pull control cables provide minimum back-lash, even in installations up to 30 feet in length, because the cable is designed to close tolerances with minimum drag and lost motion."

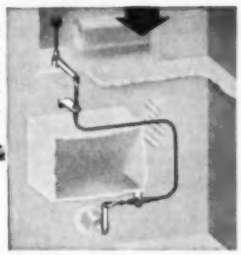
• • •

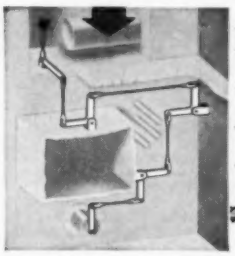
TRU-LAY PUSH-PULLS are "Solid as a rod but *Flexible* as a wire rope." This flexibility makes it possible to snake around obstructions . . . permits the ideal arrangement of all elements of remote controls.

Advantages *of Tru-Lay Push-Pull flexibility and simplicity are pictured below—*

TRU-LAY PUSH-PULL — **MECHANICAL LINKAGES**

Simple
One Moving Part
Life-Time Service
Life-Time Accuracy
Low over-all Cost
Noiseless





Complex
Many Parts
Many Points of Wear
Increasing Back-Lash
Loss of Accuracy
Vibration
Rattles

Construction Equipment and **Farm Implements** provide good examples of the wide-spread use of these accurate, simple and dependable Push-Pulls. On Power Shovels, Winches, Graders, Road Oilers, Dump Trucks, Snow Plows, Engine-driven Pumps, Crushers, Tractors, Combines, Corn Pickers, Corn Row Sprayers, Corn Detasslers, Orchard Sprayers, Power-driven Tree Trimmers, Tobacco Picking Machines and others . . .

TRU-LAY PUSH-PULLS are operating unfailingly for the remote control of Hydraulic and Air Valves, Brakes, Clutches, Transmissions, Throttles, Chokes, Governors, Power Take-Offs, Spray Nozzles, Vent Directional Fins and on many other applications.

ACCO *Our DATA FILE will answer all further questions*

AUTOMOTIVE and AIRCRAFT DIVISION
AMERICAN CHAIN & CABLE

601 Stephenson Bldg., Detroit 2
2216 South Garfield Ave., Los Angeles 22 • 929 Connecticut Ave., Bridgeport 2, Conn.

There is No Worry about Failures or Maintenance Costs with TRU-LAY Push-Pull Remote Controls

Long Life is a matter of record. We have never heard of a Tru-Lay Flexible Push-Pull Control wearing out in normal service. Failures, that sometimes harass users of more complex controls, are eliminated by the use of these simple, positive-action controls.

Dependable Operation of these controls is a certainty, even under the most adverse conditions . . . HOT as jet engines (note: Tru-Lay Push-Pulls are actually performing on hot jet applications) . . . COLD to 70° F below zero . . . SOAKIN' WET . . . ABRASIVE . . . or just plain TOUGH.

Freedom from Trouble is assured because of such features as . . . full protection of the inner, working member by the tough flexible conduit . . . lubrication of the inner, working member *for life* during assembly . . . seals that keep moisture, dust and other foreign matter out of the unit . . . cold swaging of fittings that makes them integral parts of the control unit.

Accuracy is inherent in the basic design of Tru-Lay Push-Pulls. They are precision products, not gadgets.

Capacity ranges from light jobs up to jobs of 1,000 lbs. input. These Push-Pulls will handle jobs 150 feet or more from the control point.

"Solid as a rod, Flexible as a wire rope" aptly describes Tru-Lay Push-Pull Controls. This flexibility provides positive, remote action whether anchorages are fixed or movable . . . it damps out noise and vibration . . . it greatly simplifies installation of controls by reducing the number of working parts and by making it possible to snake around obstructions.

Adaptability to all sorts of mechanical situations explains, in large measure, the wide-spread application of Tru-Lay Push-Pulls. Standard anchorages, fittings and heads have been designed that meet requirements on approximately 80% of the installations. Simple modifications of these standards, or minor changes in your own design, cover almost every special situation. Our engineers have the know-how on such matters, and will work with you.

For Further Information—The DATA FILE pictured at the left contains six booklets and bulletins that will answer any further questions you may have about this versatile and dependable tool. It is quite likely that this material will point the way to a simplified solution of your remote control design problems. Write for a copy.

Change motors in minutes—

with FALK *all-steel* MOTOREDUCERS

No long and costly "down time" involved

Motors can be interchanged or replaced *in minutes* with the all-steel, All-Motor type FALK Motoreducer. No long and costly "down time" is involved in making the change!

Best of all, replacement is not limited to original make of motor—new NEMA frames may be substituted for old. This versatile Motoreducer operates with any make, speed or type of standard foot-mounted motor within its AGMA rating. No modification, no special shaft, no "partial" motor required.

In addition to unmatched motor interchangeability, this dependable gear drive—the "work horse of industry"—offers: widest choice of output-shaft position (horizontal, vertical, right-angle)...any output-shaft connection...any mounting, including wall and ceiling...standard speed range from 1.5 rpm to 1430 rpm. All these advantages, plus proved efficiency, low maintenance and extra-long life, make the All-Motor type FALK Motoreducer your best buy for any job requirement.

Furnished in sizes up to 75 hp with any make, style or type of motor; or, *without a motor if desired.* FALK Motoreducers are available from convenient factory, field or distributor stocks, from coast to coast.

Write for Bulletin 3100

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

MANUFACTURERS OF:

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- Flexible Couplings
- Shaft Mounted Drives
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- Marine Drives
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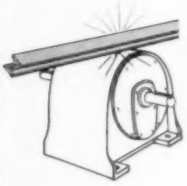
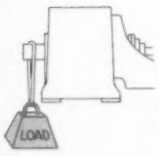
FALK "IN-BUILT" FACTORS assure full dependability—better service—longer life



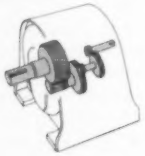
ALL-STEEL HOUSINGS

Rugged, strong, rigid ...all parts heavy steel plate, formed and welded in the Falk Weld Shop.



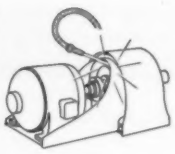
LARGE OVERHUNG LOAD CAPACITY

Large shafts, oversize bearings...rigid mountings with wide bearing spans to handle maximum loads.



PRECISION GEARING

Heat-treated alloy steel gearing, precision cut and shaved after heat treatment to eliminate distortion.



SEALED HOUSINGS

Splashproof, dustproof, oiltight. Dual closures and one-way vents keep oil in, dust and moisture out.

notes from britain

By FRANK G. WOOLLARD
British Correspondent

The control room for a reactor at Calder Hall nuclear generating station typifies the two technological forces of most interest to Britain: nuclear energy and automation. The Calder Hall installation was the first full-scale nuclear power station to go into operation in any country.

Tailoring Education To Suit

THE ADVENT of automation and realization of the possible development of nuclear energy has provoked much discussion in this country. Much has been said by politicians of all colours about the necessity of increasing educational facilities to cope with the new situation. The reports of the greatly increased output of technically trained men in the U.S.S.R. and also, of course, in the U.S.A. has high-lighted the need for reconsidering the British education system. Our primary need is for more technologists and many more technicians rather than more men trained for pure science.

The 1944 Education Act raised the school-leaving age from 14 to 15 years and this will be extended to 16 years when the situation permits. Further education beyond the school-leaving age is now a statutory responsibility. The act provides for compulsory education of the young entrant to industry, under 18 years, for one day per week. Moreover it is now possible for an intelligent child to proceed from the primary school to the secondary school at eleven years of age and to stay there until 18 years at which time he can go on to a university: the state or the Local Education Authority providing funds when necessary.

But it is also necessary to cater for those who do not quite make the grade. Here the technical colleges are all-important and a large expansion is visualized in this field. The funds allotted to the plan will provide more colleges at strategic points and will free some of the larger colleges from elementary work. There will, thus, be a larger number of local colleges for men under 18 years.

There will also be area colleges staffed and equipped both for elementary and advanced part-time courses; regional colleges will provide full and also part-time educational facilities for technologists and higher grade technicians. In addition a small number, ten is the figure suggested at present, of advanced colleges of technology which will not be hampered by elementary teaching will be set up. All these colleges will be linked together through regional advisory councils for further education which will comprise representatives from local authorities, technical colleges, universities and industry. The examination system is to be tailored to suit.

Sandwich System

Coupled with all this is a growing appreciation of the need and value of formal apprenticeships which had, more or less, fallen into desuetude between the two World Wars. More and more employers are adopting the sandwich system which enables technical education to proceed hand-in-hand with practical experience. The writer devised a method which divided the first three years into 4-month periods and the second two years into 6-month periods. At the end of the third year the apprentice would normally have passed the Ordinary National Certificate and at the end of the fifth year the Higher National Certificate.

During the 3-year period the apprenticeship would serve four months in his chosen trade, four months in an allied craft and four months at the local technical college. Each successive year would follow the same pattern except that the allied craft would change, but the chosen craft would be the same.

At the end of the 3-year period the successful apprentice would be asked if he wished to change his vocation as he might well do after gaining so much experience; for instance, he might have wished, originally, to become a die-sinker

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but on closer acquaintance with industry he might wish to become a draftsman. In such case for the second or 2-year period his rotation would be 6 months in the drawing office and 6 months at the technical college.

At the end of the five years he would have the choice of a twelve-month special course or of serving 12 months with an associated company. Where it would be of obvious benefit he would be given the opportunity of entering a university.

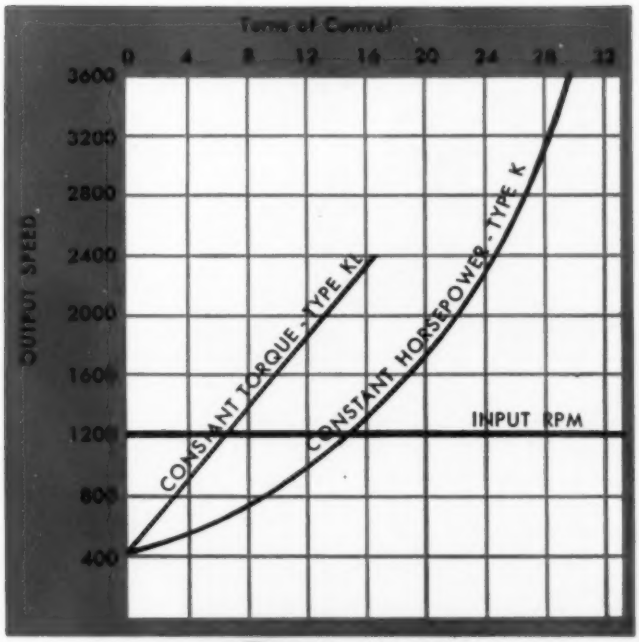
The smaller concerns are also becoming very interested in apprenticeship training but realize that often they are unable to give their apprentices an all-round training; so they have, under the aegis of the Engineering Industries Association, arranged for an interchange of apprentices to ensure that their young men will not be overspecialized: For instance the proprietor of a small machine shop may well pass his apprentices to a firm which specialises in foundry work, in sheet metal or in plating or finishing. These men become more useful members of the sponsoring company than they could ever have been under the old system: moreover the employers can pick out the men that would best suit their particular establishment and, by mutual arrangement, offer them employment.

There has, so far, been no specific curricula for automation, it being generally recognized that the best training is in the fundamentals of the sciences with some intensification in electricity and physics leading to electronics, and mathematics to enable the student to grasp such techniques as programing for numerical control operations. In the production engineering courses, automation has its place among many other production methods. It is also appreciated that with the changing face of industry (where so much reliance is placed on automatic machinery) there will be a need for a new appreciation of industrial administration and this is a subject in which great strides have been made. The courses at the Birmingham College of Technology cover a wide range of subjects of which the following is an abbreviated example: Product design, factory organization, work study, management principles, management practice, industrial economics, market research, industrial accounting, factory costing and estimating, budgetary control, and office organization and mechanization.

Ubiquitous Interest

Although there are no specific curricula on automation many of the technical colleges are promoting automation courses of six to eight weeks duration. These courses consist of weekly lectures which, with questions and answers, occupy 2 to 2½ hours. Occasionally they have one lecturer for the whole course but, more often, they choose a number of experts on various aspects of automation, e.g. transfer machines, controls, electronic applications and so forth. The writer has spoken at universities, technical colleges, engineering institutions and associations throughout the length and breadth of the land and can vouch for the great interest and appreciation of the audiences. Such lectures are, of course, on the appreciation rather than the penetration level. It is interesting to note that the audiences are by no means confined to the automobile industry nor, indeed, to production engineering. They come from all industries for, as one wit expressed it: "Automation interests all trades from fissionable materials to fish processing".

One aspect that is very noticeable is the tremendous interest all audiences take in the social implications of automation. This arises from the fact that the popular press have jumped on the automation "band wagon" and they and certain of the Trade Union leaders, not, be it noted, the Trades Union Congress, have overemphasized the possibility of redundancy—as we now call that form of unemployment which it is hoped will be of short duration. It is to be regretted that our automobile companies suffered a severe recession during the past twelve months for this has given credence to the antiautomation Jeremiahs which is not justified by the facts. That, however, is a very long and complicated story.



Typical speed regulation curves for the Types K and KL Variators. Type KL offers a linear speed regulating pattern, often an advantage in automatic control applications. Output speed regulation of the Type K Variator follows a geometric progression pattern. Starting at the minimum output speed, each turn of the speed regulating wheel produces a fixed percentage increase in output shaft speed.

The Cleveland Speed Variator is available in 18 models ranging from fractional to 16 HP at 1750 input RPM. Unit shown at right, used in process control, has speed regulating worm driven by 75 RPM synchronous motor, with adjusting shaft indicating mechanism modified to actuate limit switches to prevent overtravel.

CLEVELAND SPEED VARIATOR

Accurately Provides Dependable, Infinitely Variable Speed Control

ANNOUNCED late in 1954, the new Cleveland Speed Variator met instant, enthusiastic acceptance. Engineers and designers of industrial equipment already have put thousands of units into use on such varied equipment as cigarette making machines, textile machinery, metalworking machinery, pharmaceutical equipment, transfer tables, conveyors and experimental and testing equipment of many types.

Infinitely variable, the Cleveland Speed Variator gives stepless speed over a full 9:1 range—from ⅓ to 3 times input speed. Output speed can be adjusted by either a hand wheel on the Variator or by manual or automatic remote control.

The Cleveland Speed Variator offers these major advantages:

1. An extremely compact unit with input and output shafts in line and rotating in the same direction.

2. Almost any input speed up to 1800 RPM can be used—either clockwise or counterclockwise rotation.

3. Rated for constant horsepower output over a 9:1 or 6:1 range; or for constant output torque over a 6:1 range.

4. Speeds infinitely variable over entire range of adjustment.

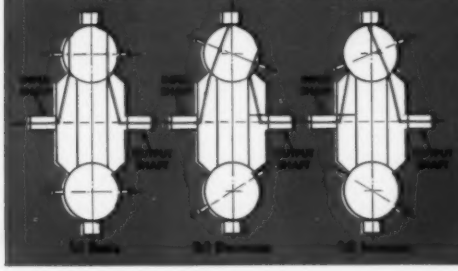
5. No slippage—positive torque response mechanism adjusts in direct proportion to the loads encountered.

6. Long life and minimum maintenance due to absence of belts or complicated linkages.

7. Ample bearing support for overhung pulleys on both input and output shafts.

Write for Bulletin K-200 for detailed description with photographs, sectional drawings, rating tables and specifications.

HOW THE CLEVELAND SPEED VARIATOR WORKS



Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts.

Relative speeds of the shafts are adjusted by changing the positioning of axles on which the balls rotate (diagram, right, shows cutaway Variator with hand regulating wheel).

"It's the Drive That's on the Ball."

THE CLEVELAND WORM AND GEAR COMPANY

Speed Variator Division, 3265 East 80th Street, Cleveland 4, Ohio

Sales Representatives in all major industrial markets • In Canada: Peacock Brothers Limited.

Here is CONTROL!

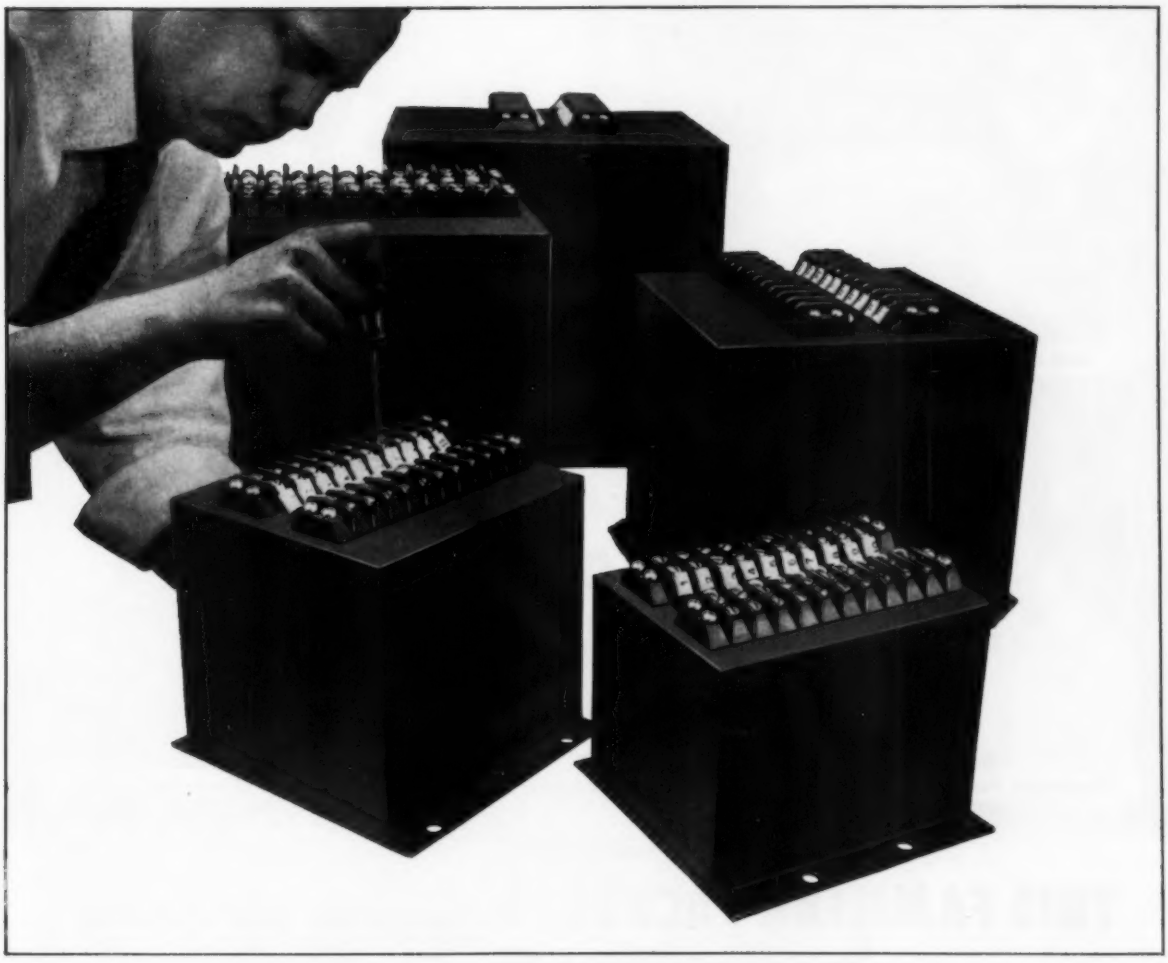
May 1. Important news to engineers concerned with industrial control is announcement of standardized high permeability magnetic control devices now available from "Control," a division of Magnetics, Inc., Butler, Pennsylvania.

"Control's" first products are standard lines of saturable reactors. Twenty-two catalogued reactor assemblies will be stocked and are ready for rapid delivery.

Establishment of "Control" is a major step forward in permitting engineers to take full advantage of long life and ruggedness features of high permeability magnetic devices. It takes these units from the custom-order to the mass production stage with important benefits in engineering convenience and dependability.

In recent years, high permeability magnetic devices have made real inroads in the industrial control field. CONTROL reactor assemblies may be used for such diversified applications as motor control, voltage regulation, automatic battery charging, arc welding control and power amplification of the minute outputs from many types of transducers.

Engineering sales representatives are located in many key areas in the United States. Advertising appears in leading trade publications in May, based on the theme "Reliability Begins With CONTROL."



Now--CONTROL offers you standardized saturable reactors

If you're a design engineer who would be delighted with industrial components which are sensitive and, under normal operation, last virtually forever with no maintenance or servicing, then you'll welcome CONTROL's *standard* lines of saturable reactors.

With CONTROL reactor assemblies and magnetic amplifiers, you know complete physical and operating characteristics —a copy of our Catalog R-10 awaits your request. And, delivery is fast because sub-assemblies of these units are stocked, awaiting your control-winding specifications.

CONTROL reactors are available for both 120- and 240-volt 60-cycle operation. There are eleven standard sizes in each voltage range. They have extremely high gain. Six ampere-turns control nearly 2,000 watts in the largest size. Power outputs range from 50 to 2000 watts, with only 2 ampere-turns required for control of the smallest units.

In addition to higher gain, smaller exciting current, and fewer ampere-turn characteristics, CONTROL reactors have a 40 to 1 cut-off ratio. They are totally enclosed so that the high performance toroidal cores used are protected, and the entire assembly has the ruggedness required for long life.

CONTROL offers the same convenience of standardization in use of high permeability magnetic devices that you've enjoyed with other components. Add to this convenience ruggedness and freedom from maintenance which is unmatched, and you'll welcome CONTROL to your design picture. Write for complete details and literature today. *CONTROL, Dept. A-36, Butler, Pennsylvania.*

Reliability begins with CONTROL

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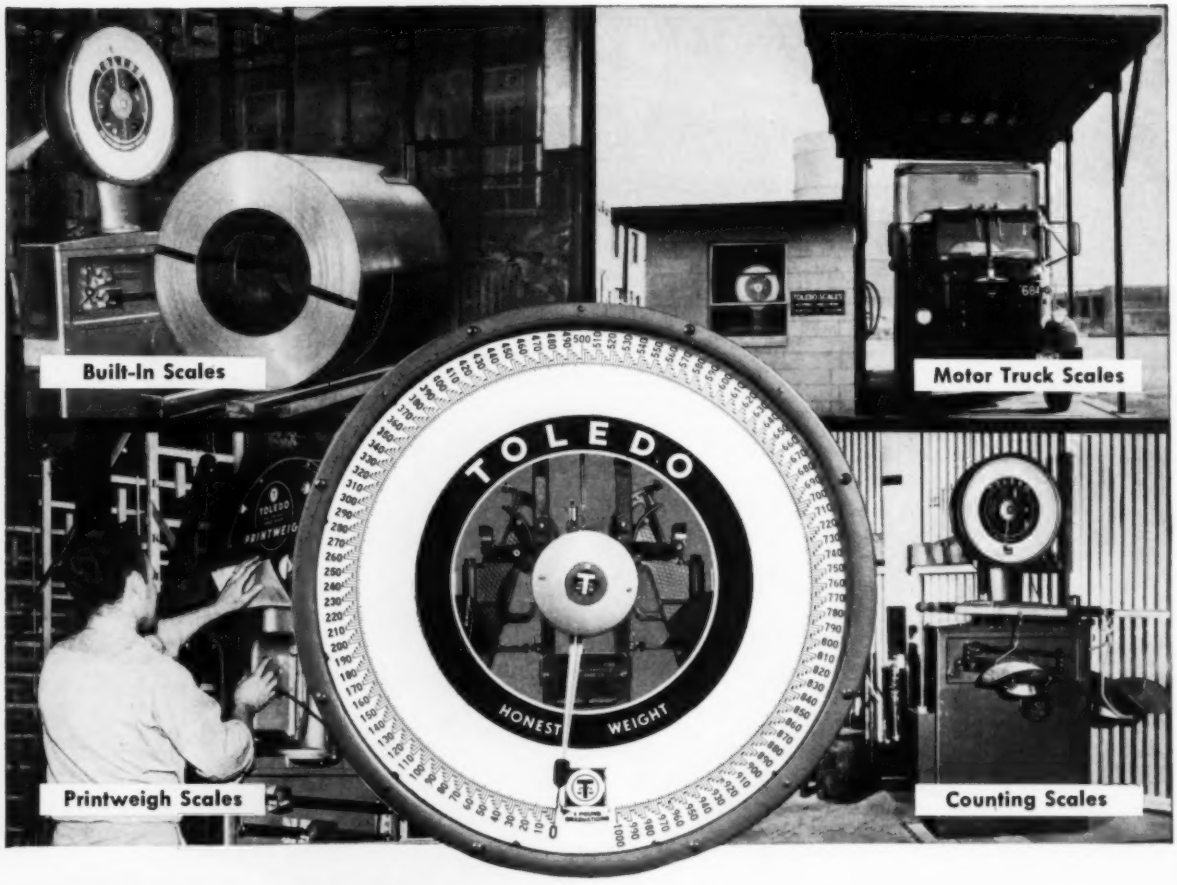

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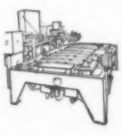

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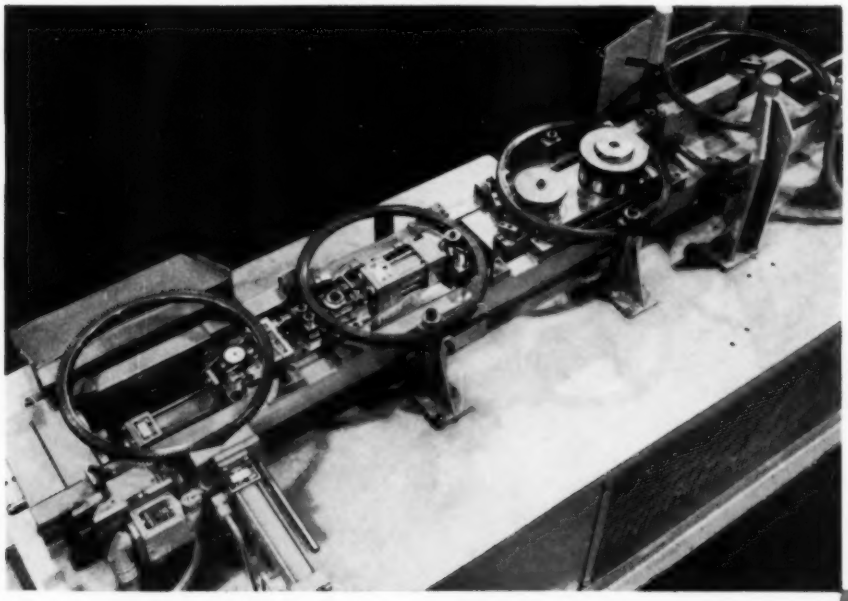

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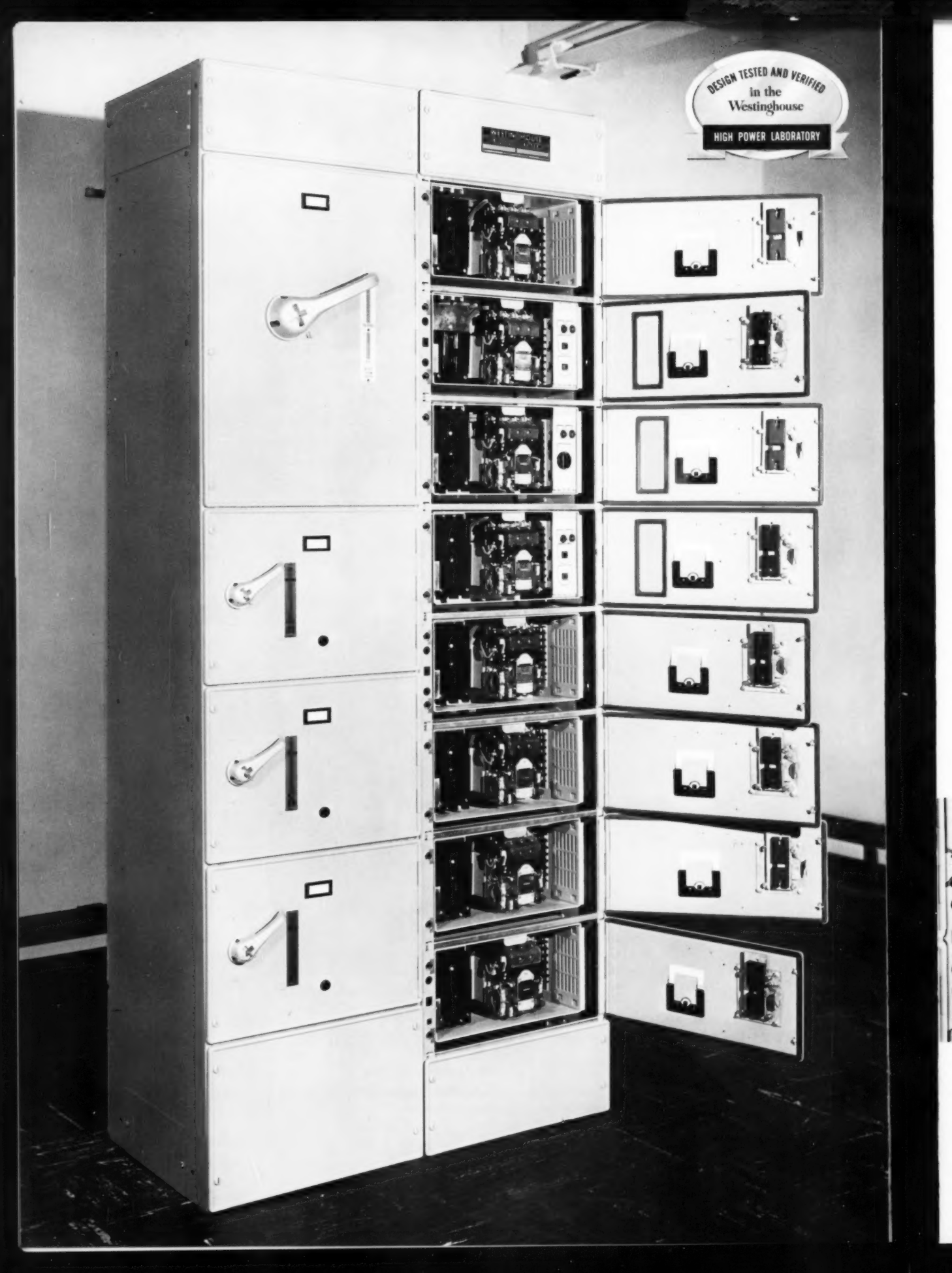
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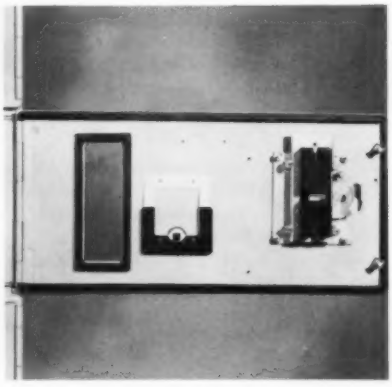

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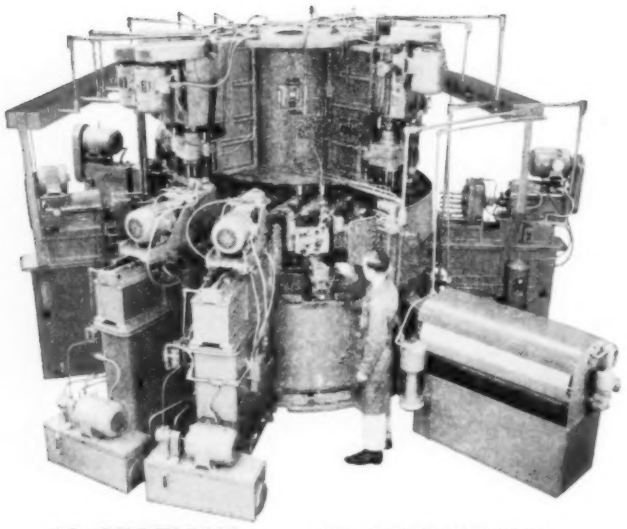

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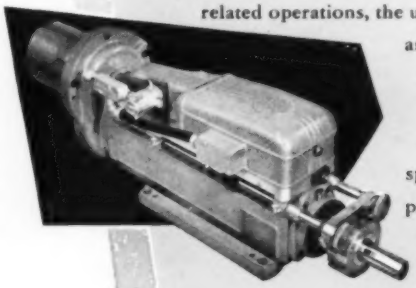

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Implementing the Program

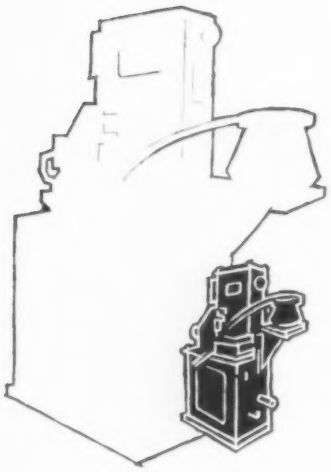
One of the difficult problems in developing effective automation is the decision as to the most suitable type of production equipment. Evaluation and decision efforts are restricted in great degree by experience and understanding.

For one thing, the men whose responsibility it is to develop integrated manufacturing systems cannot master overnight the intricacies of the expanding legion of new machines, methods and automatic systems. Keeping abreast of today's fast-moving developments is a major problem in itself. There is a real need to study and become acquainted with accomplishments not only in competing industry but also in unrelated areas of manufacturing.

To aid in the study of fundamental approaches to manufacturing automation, a special roundup of basic techniques is presented in this issue. Covering a range of applications from standard equipment to completely special production systems and adaptability from job-shop operations to volume production, this roundup brings together a wealth of practical data. It can serve as a useful guide to future automation planning.

Suitable implementation of any program developed—the selection and integration of production equipment for complete processing of the product—can be the most critical phase encountered. Study of successful techniques will help in attaining the real potentials available through application of the "right" type equipment for any particular set of business circumstances.

EDITOR



evaluating production equipment

FOR AUTOMATION

The First Conference on Manufacturing Automation, held at Purdue University, was developed to help promote a better understanding of both manufacturing automation technology and its practical application. One area of outstanding importance covered in this comprehensive Conference study concerned the evolution of production processing equipment for effective automation implementation. Here, in this special editorial section, are the basic approaches considered: (1) Using standard equipment integrated into a continuous line; (2) applying "building block" techniques to develop special-purpose machines and lines; (3) solving the automated production problem with transfer type equipment; and (4) developing entirely special-purpose production equipment from "scratch" where conditions so demand. Today, to complete the study a fifth approach must be considered: the application of tape or punched card controlled machines for shorter runs and job lots. Decisions concerning optimum production equipment are becoming increasingly involved. This guide will assist materially in evolving eminently suitable results.

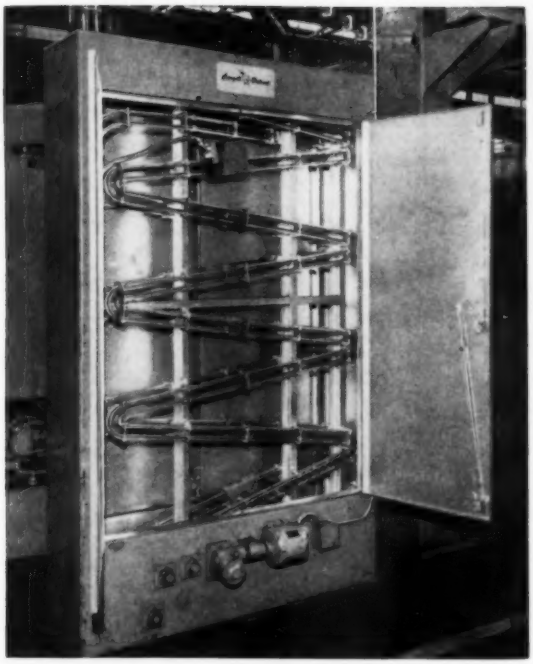


Fig. 1—Automatic float receives parts from one operation at random rate and discharges parts to next operation at any required rate.

By D. A. CARGILL
President
Cargill Detroit Corp.
Birmingham, Mich.

USING STANDARD EQUIPMENT

Making the final decision as to the type of manufacturing automation to be used requires a study of the various primary approaches. There is the possibility of using standard equipment with available and/or specially designed attachments and devices. What are the attributes and economics?

WHEN YOU manufacture a part you do more than just work metal. Handling of the material, the inspection of material, and the handling of information such as part size, inventory control, scheduling, etc. are all necessary. In short, manufacturing a part requires a system that will produce that part. To produce apples you need an apple tree; to produce parts you need a production system.

We can recognize that the entire automobile is produced by a system and the piston pins or spark plugs or individual parts are likewise produced by smaller systems. The common version of a manufacturing system is a combination of machinery and people. Sometimes we find manufacturing systems that consist predominately of machinery and very few people. An example would be the soft drink bottling industry where materials are handled automatically, processes are automatically controlled, and a good deal of information is handled automatically. The production of plastic clothes pins is another example of a system that is predominately machinery. With an injection moulding machine, you have a system that involves very few people. Automation is helping to bring more of these systems into existence.

As there are numerous types of automation there are numerous ways of developing the manufacturing systems. Stated another way, industry has a common goal—the automatic factory—and we can get there by many ways. The integrated line is a systems enginering approach to the automatic

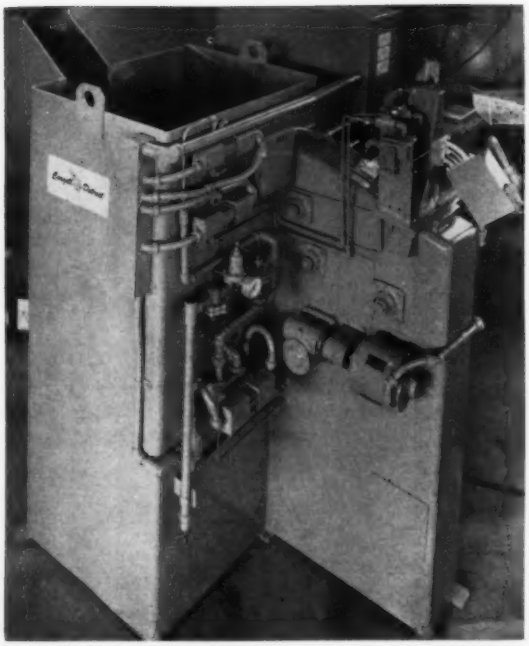


Fig. 2—Bulk storage hopper receives parts in bulk, orients them and injects the parts into the line as needed.

factory that is evolutionary rather than revolutionary, and the fact that the integrated line is evolutionary should be stressed. Why should it be stressed? There are many people involved in our present manufacturing systems and they have been trained in the conventional manner. It is almost impossible to change from a system consisting of part machinery and part people to one with no people and do it economically. It is difficult for management, maintenance people, production control people, inspectors, not to mention how difficult it is for machine designers and builders. The successful, revolutionary ideas are not on tap.

On the other hand, the evolutionary integrated line as a system for manufacturing parts is more easily obtained. The integrated line consists essentially of conventional machine tools tied together with readily available, easily designed, materials handling equipment and an automatic control system for the purpose of safety interlocks and some rudimentary information handling. An integrated line as a manufacturing system contains machine tools for working the materials; materials handling equipment for material transportation and machine loading and unloading; and automatic controls for regulation of the system as a whole as well as regulation of individual units. Automatic materials handling equipment might be special but many of the components are standardized in their basic design. Automatic information handling equipment or automatic controls is not complicated; many times it is nothing more than a limit switch and a few feet of wire so that we can have a remote signal as to when a machine magazine is full or a part has been rejected.

▶ Advantages of Integration

The basic idea of an integrated line is that any machine in the line can demand a part and the system will furnish the machine with a part. This demand system is prevalent throughout the entire lineup of equipment. Some of the outstanding features of integrated lines are:

1. They utilize conventional machine tools which are already in existence and require no development. The tools may even be presently in use in your plant.

2. The machine tools do not have balanced rates of production and are not synchronized with each other.

3. A system such as this utilizes current skills of people on your payroll. They are familiar with the machines and their tooling and are not unfamiliar with the components used in the integrated equipment.

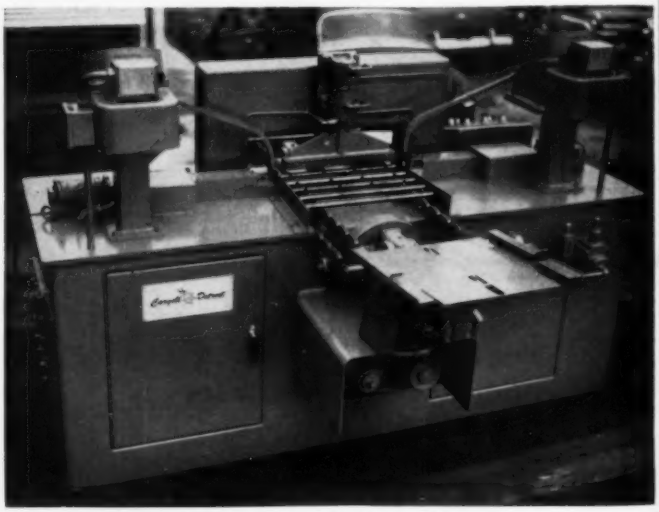


Fig. 3—Special machines can be developed for assembly such as in this example in which oil seal plugs are placed in each end of a shaft.

4. It is low cost automation. The usual figure for the cost of such a system is approximately 20 per cent more than the cost of the conventional machine tools alone.

5. An integrated line can be quickly designed, built and installed. Lead time on this type of equipment is four to six months.

6. The line can be purchased with confidence that it will manufacture the part. Your processing people know that the metal working equipment will do the job. If bottlenecks develop they will be dealing with familiar problems.

7. Installation of such lines is not disruptive since a portion of the integration equipment can be

Fig. 4—Special test machine used in integrated line automatically handles 1800 hydraulic valves lifters an hour. Parts are gripped by machine and a load applied to test a brazed joint.

put in and be used while awaiting installation of the balance.

8. A less tangible advantage, but possibly one that contributes the most towards reduction of cost when using such a system, is that the demand systems insures complete machine utilization. Whenever a machine tool requires a part it immediately gets a part. One does not have to consider average operator rates, comfort, etc.

9. Another less tangible advantage is control of float size. With automatic storage feeders between operations, large banks of material can not accidentally build up. Floats are automatically maintained between specific maximum and minimum values.

10. Scrap control is excellent. Rejects are brought to the attention of supervision immediately by the automatic inspection and rejection equipment. This prevents additional work being done on a part that has been scrapped by a previous operation.

11. As new processing equipment is developed it can be put into the line, or new processing equipment can be incorporated simply to replace worn out equipment without affecting the line operation.

12. Almost all of the cost reductions available through programs familiar to your people such as better tooling, better loading, improved cycle time, etc. can be applied to the integrated line.

In handling a project involving the integration of equipment in a production line, specifications can be drawn up for the entire line. Throughout the project, the responsible engineer constantly checks equipment components to make sure all of the specifications are met. Some typical specifications are: That the system will operate on a demand principle; the line will have no dead stock; there will be no unavailable float; there will be no recirculation of parts; the first part in at the head of the line will be the first part out at the end of the line; a part cannot be taken from the line at any point except after a gage; a part cannot be reintroduced into the line at any point except ahead of a gage; the line must be capable of handling a number of specified part sizes; a particular part may require handling without sliding; anti-coincidence devices or circuits will be employed wherever potential dam-

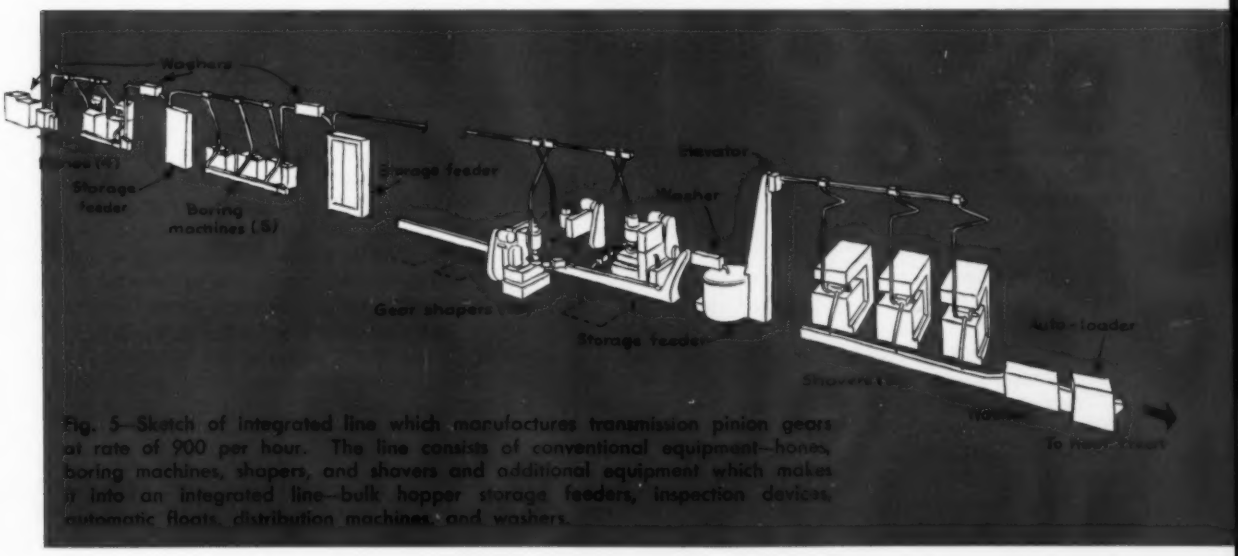
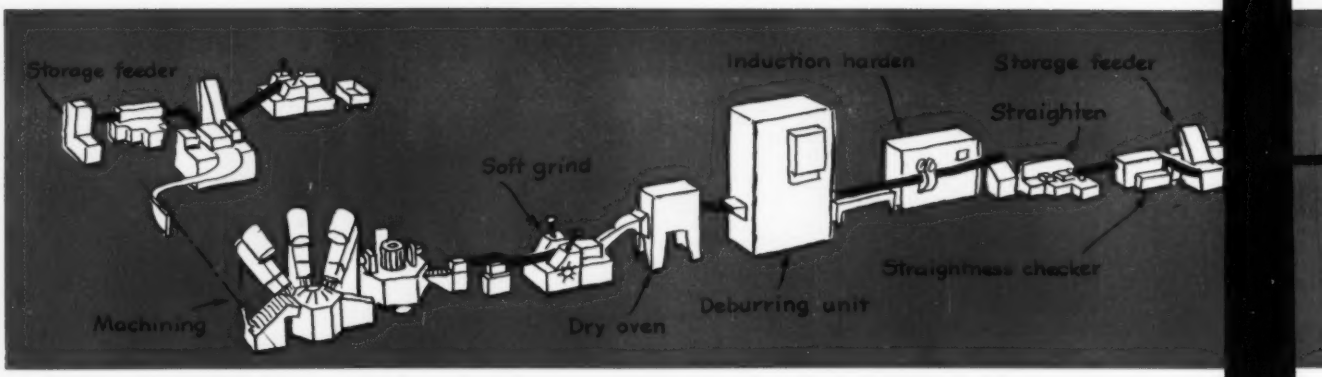


Fig. 5—Sketch of integrated line which manufactures transmission pinion gears at rate of 900 per hour. The line consists of conventional equipment—hones, boring machines, shapers, and shavers and additional equipment which makes it into an integrated line—bulk hopper storage feeders, inspection devices, automatic floats, distribution machines, and washers.



age to the part or equipment exists; parts in transit will never touch one another; storage will be provided between each machine; etc. Obviously, the specifications can be tailored to suit a specific line.

Examples of Components

An appreciation of the potential in equipment integration can be gained from a run-down on some of the standardized components used in some of these lines. It is to be understood that I am using the word *standard components* loosely. In our organization we mean that a unit is standard for a particular integrated line, in that the usual line will involve four to ten similar units which can be standardized. Naturally, the design ideas and many of the detail parts can be standardized as in any class of equipment.

One of the most common automatic materials handling items used in these integrated lines is referred to as an automatic float, *Fig.* 1. The machines or banks of machines doing one operation operate at different production rates, and are susceptible to different types of downtime. It is a good idea to have a float of parts between each operation. And, of course, in an integrated line this float has to be automatic. The automatic float will receive parts from a preceding operation at any random rate and at any time. Likewise it will discharge parts to the following operation at any required random rate at any time. For example, a typical integrated line for manufacturing pinion gears would have five to eight automatic storage feeders that will each hold 500 pinion gear blanks with or without the teeth. The gears are maintained in proper orientation so that thrust faces will not slide against any part of the equipment, and the first gear entering the storage feeder will be the first gear to leave the feeder. Part sequence is maintained. In one the parts may move by gravity. Another might be full of moving fluid to push parts and cushion impacts.

The other most common item used in integrated lines is the distribution machine which is used to feed a bank of machine tools doing the same operation. It receives its parts from an automatic float and feeds the individual machine tools on demand. If the machine tool requires a part, the distribution machine immediately feeds it a part. This demand of the machine tool is sensed by the distribution machine without interconnection to the machine being necessary. From the bank of machine tools a simple conveyor collects the parts, maintaining orientation, and deposits them in another storage feeder which in turn feeds the following operations or following distribution machines. The demand on the distribution machines may be simultaneous and in effect they will be filled simultaneously. This is how maximum machine utilization is obtained—by never ignoring a demand or having a time lag before demand is recognized.

At the head of many lines is another type of device—the bulk storage hopper. This hopper receives parts in bulk, orients them, injects them into the line or into the distribution machines for feeding to the magazines of the first operation, *Fig.* 2. It is possible to have a sorting gage incorporated with the orienting mechanism of the hopper feeder to reject any blanks that are out of tolerance, etc.

Specials May be Needed

In the development of an integrated line there is sometimes the problem of the conventional machine tool not filling the bill. Most conventional machine tools today are available with through-feed in that they have magazines for loading and automatic unloading. In integrated lines these magazines will be used except they will not be hand loaded. However, some machine tools are not susceptible to through-feed. One example might be a lapping machine that cannot be turned on until it has a full load. Without a full load it will automatically shut off and needs manual reset. When something like this arises it is necessary to design a special machine for this one point in the line. A through-feed straightening machine is an example of such a special machine. This machine has a magazine that is loaded with parts from heat treat. It straightens the shaft to a total runout of one and a half thousandths and feeds it into a centerless grinding operation.

Many times the machine that is not available is an assembly machine for use somewhere near the end of the line. For example, we have developed an assembly machine for rocker arm shafts where

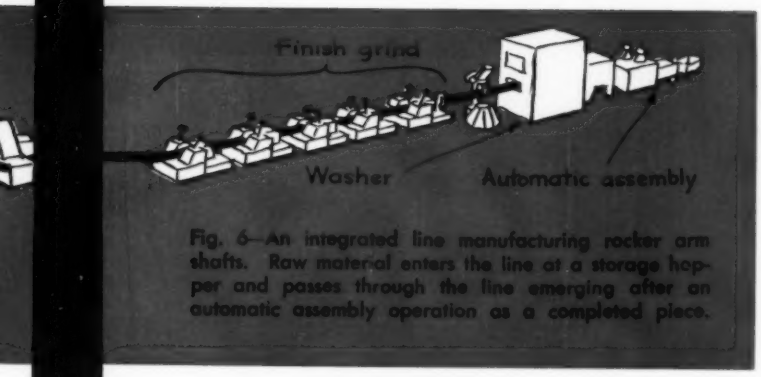


Fig. 6—An integrated line manufacturing rocker arm shafts. Raw material enters the line at a storage hopper and passes through the line emerging after an automatic assembly operation as a completed piece.

it is necessary as a final operation to have a through-feed unit for putting oil seal plugs in each end of the shaft, *Fig.* 3.

Another example of a special machine would be a through-feed automatic testing unit for testing a part for strength of braze, *Fig.* 4. This unit handles 1800 parts an hour. The part is an hydraulic valve lifter which is gripped in its finished assembled stage on the OD while a 3000 pound load is applied on the push rod seat to see if brazing failure will occur. If there is a failure, the part is rejected from the line.

From these descriptions of some of the individual devices which are used to develop the integrated line it can be seen that we have not used any units conventional machine tools or design practices that are too costly or that are too revolutionary for most operating personnel. It is predictable that the line will work. It is predictable that the cost of the integration will not be more than 20 per cent of the price of the machine tools and their tooling. It is predictable that there will be operating economies through greater machine utilization. It is predictable that quality will be up and work-in-process will be down.

▶ The Integrated Line

These points can be illustrated by reference to integrated lines that are now in existence. One such line automatically manufactures transmission pinion gears at a rate of 900 gears per hour, *Fig.* 5. The raw material is fed into the line at a bulk hopper storage feeder as a screw machine blank. It is ejected from the end of the line as a finished gear. In this line there are 46 machine tools. The hobbing is a particularly critical operation and following every hob the parts pass through automatic inspection devices that check the gears and rejects those that do not meet standards. Upon rejection this device can also signal the hob to correct itself to compensate for hob wear or shut the machine down. The automatic floats allow the equipment to be taken off the line for routine maintenance, setup, etc., without affecting the operations of the rest of the equipment. None of the equipment in this line is synchronized with any other equipment. The distribution machine feeds one bank of 11 hobs from a float. Machines operate at a different random rate. There are times when many of the machines in the line are not needed to meet the production schedule and are simply turned off. The float and distribution machine then automatically do not feed these machines any parts. Their demand has been eliminated and the line may run at a reduced capacity with no adjustment at all. In this line there is no place where a gear can be put into the line except at the beginning when it is a screw machine blank. This blank is inspected for proper dimensions before it is allowed to progress through the line.

Another example of an integrated line manufactures rocker arm shafts, *Fig.* 6. Raw materials go into a storage hopper at the beginning of the line and come out of the final assembly operations as a completed shaft. In developing this line, two special pieces of through-feed equipment had to be built so that the line could operate, a through-feed straightness checker and an automatic assembly machine.

Integrated lines have been built and can be built for the processing of gears, shafts, pins, bearing races, rocker arm shafts, automobile engine pistons, differential stem pinion gears, crankshafts, hydraulic pump rotors, stators and vanes. In working on these integrated lines it is interesting to see the need for special machines fulfilled. Some of them are purchased from conventional machine tool builders and some we make ourselves as part of the integrated line. They later find use in similar applications and many become conventional tools in time.

One of the most interesting special machines that we have developed is an automatic size control device that has fairly universal application to any machine that tends to go off size at a rate. The rate may be due to thermal problems, tool wear, grinding wheel wear, etc. Some integrated lines require a good deal of control to really be classified as automatic. For example, it is no good to have automatic materials handling on a grinder if the operator has to be there to maintain the part size. The special size control machine which we developed forces the grinder to grind good parts. The control compensates for the rate that the machine tends to go off size, rather than compensating for a part error. In this manner an error does not have to be made to get correction.

As a summation, the integrated line is a system for manufacturing parts. It is a combination of conventional machine tools and materials handling equipment with an overall automatic control system. The integrated line is for the man faced with the problem of producing more or producing better or producing cheaper and who can't wait for the development of a complete new process or a complete new automatic factory. He is the man who cannot spend large sums of money to get his automatic factory. He has to do the best with what he has and he has a definite production deadline to meet. He may want to use many of the pieces of equipment already on his floor. This is the man the integrated line is designed to satisfy.

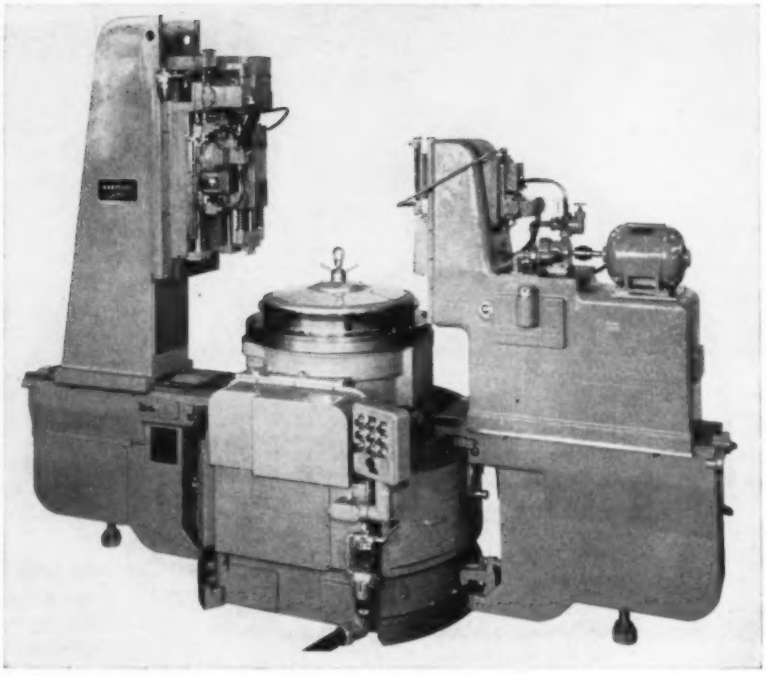


Fig. 1—Universal drilling machine developed by the Hartford Special Machinery Co. provides a standardized basic machine to which standardized components can be added to meet special requirements.

APPLYING "BUILDING

By P. H. RICHARDSON
Engr. Vice President, The Hartford Special Machinery Co., Hartford, Conn.

THE IDEA of using so-called building blocks or components in the construction of production machinery is not particularly new, despite all publicity to the contrary. A number of machine tool manufacturers have been using the basic principles for some time, reluctantly in certain cases to be sure. While some of the oldest machines had a cast frame that comprised all but the moving parts of the machine, as time went on and particularly as the machines became more complex, most machine tools were made of two or more sections fastened together. Initially, division of a machine into sections did not usually follow functional line, the division being selected to facilitate the machining or casting of the various sections. As time went on, standard machine tools gradually developed along functional component lines as, for example, a lathe where a choice of swing capacities can be obtained by the use of riser blocks on the headstock, tailstock, tool posts and turret. Drill presses can be arranged to provide any number of various types of spindles in a single assembly. Variable position, multiple-spindle drill presses may be obtained with a choice of column heights, table types, numbers and capacities of spindles and other variations such as, jump feed provisions, etc. Usually, these variations are accomplished by the selection of various standard elements to provide the required specifications.

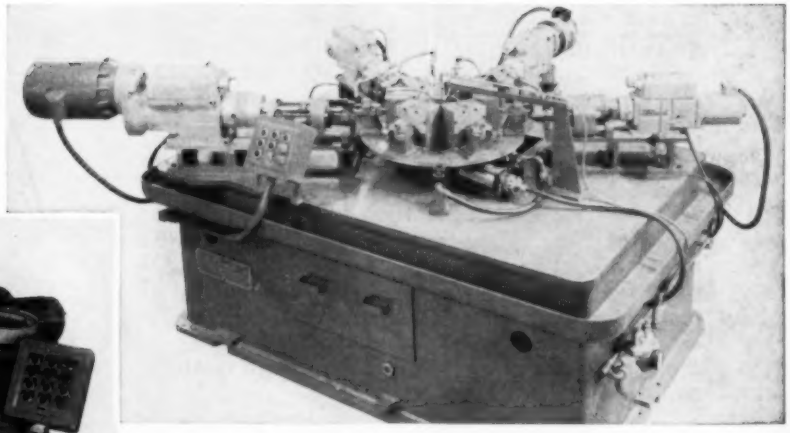


Fig. 2—The "building block" principle can be applied to various sizes and types of machines. In all cases, flexibility of component arrangements is an outstanding feature.

BLOCK" TECHNIQUES

When choosing equipment to implement an automation program there is the possibility of using "building block equipment" to build-up semispecial machines. This approach has considerable merit and its attributes and economics should be carefully evaluated for suitable results.

▸ Use of Standard Components

The early special purpose production machines were truly special but today there are very few machines that do not have some components that are common with other machines. The class of production machines commonly called "Special Drilling Machines" will serve to illustrate the point. These machines are the type that in addition to drilling, also perform tapping, milling, broaching and other operations. They may be of the rotary index or transfer type or variations of either. Of these two types, the rotary type predominates for a number of reasons and will be used for illustrative purposes here. They come in all sizes and perform many different operations on an almost limitless variety of parts. Most present-day machines are made up of a number of components, which are more or less standard with the manufacturer of the machine, combined with a number of specially-designed parts peculiar to the machine in question and designed particularly to process a specific part.

The more operations that are incorporated in a particular machine and the higher the production requirements, the more special the machine tends to become. This is due principally to the fact that the economics of the situation will justify

a specially-designed and manufactured component which will save a small amount of time on each piece but due to the large number of pieces to be run over this machine in the course of its life, the total dollar savings greatly outweigh the cost of the special component. There are, of course, some machines that are practically all specially-designed components. These, however, are the exception and are opposed, on the other hand, by a number of machines that are made up out of almost completely standard parts.

As a special machine tool manufacturer accumulates experience and builds more and more machines, he finds that he can fall back on previous designs to a greater extent. Eventually, some of these previously designed components will become a manufacturer's standard because they are utilized in so many instances. Or, a manufacturer may become aware of a requirement for a particular component filling certain requirements. This particular component may never have been previously manufactured in exactly the form that a careful analysis of the requirements would indicate it should take. In this case, the standard design is the result of a rather careful analytical engineering study of the requirements. In either case, the end result is the same. A series of standard components, or building blocks if you prefer, will be utilized time and time again in the construction of special purpose machinery. An example would be the type of machine shown in *Fig.* 1. We find that it is composed basically of the main machine base which, in turn, supports a dial or index table in the center or nearly in the center of the machine. Around this center are arranged a series of units which perform the actual operation. The part is held in a number of fixtures mounted on the index table. Some of these machining units are mounted with their axis horizontal or at some angle between horizontal and vertical upon riser blocks, sliding subbases or similar devices. Others are mounted with their axis vertically on columns. In a number of cases, multiple spindle heads or milling heads are used as a particular job may require.

Drilling Machine Components

We can make up a list of more common components comprising a special drilling machine. They are: base, index table, drill head, drill head attachment such as milling head, multiple spindle head, tapping head, sliding subbases, riser blocks and columns. There are, of course, the special parts required to hold or process a specific part being manufactured. These comprise usually, the fixture, bushing plates, certain angular columns or other parts peculiar to that particular operation. To these are added a number of special tools such as form cutters.

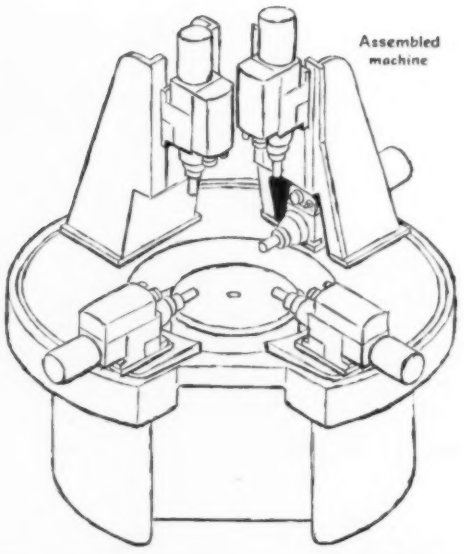
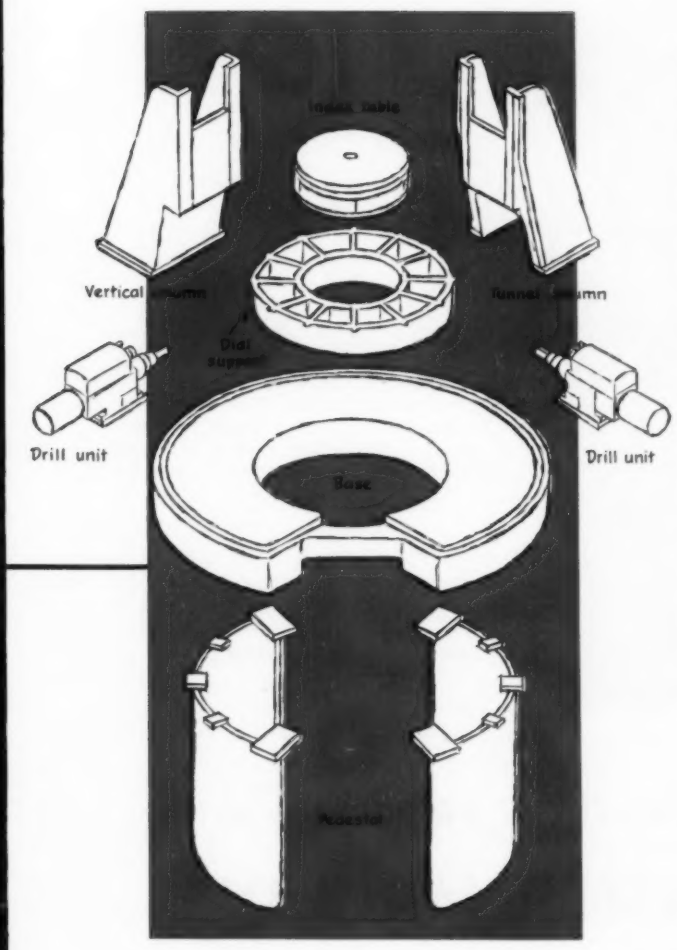


Fig. 3—Machine components which are assembled to form the basic production equipment are typified by these parts. Additional items, such as fixtures, would be special for a given job.

Examination of a number of drilling machines will indicate that, basically, these standard components are utilized on all of them. This leads to the idea that perhaps if the component parts were sufficiently universal, it might be possible to use a group of these component parts on one machine and when that machine had served its purpose, re-use these parts on another machine. This basic idea has led to two different approaches, one of them being the Hartford Special Universal Drilling Machine as shown in *Fig.* 1. This machine, basically, is designed to process various parts of jet aircraft engine parts. All of these parts are basically of a round or cylindrical shape with flanges through which are drilled various sized holes in varying numbers, spaced at regular or irregular intervals on one or more bolt circles. The problem encountered in the aircraft engine industry is that the frequency of design changes requires the use of flexible production equipment. In addition, comparatively small quantity of parts are produced. In order to meet these specific problems, this machine was designed so that it could be altered to fit the changing conditions.

The second approach resulting from the basic idea is perhaps indicated best by considering an example of that class of machines that have been manufactured by machine tool manufacturers, by parts manufacturers in their own plants, and by small tool and die shops, *Fig.* 2. These machines have an automatic cycle that completes the operation the machine is designed to perform once the operator has pushed the cycle start button. If you will analyze these types of machines, you will see that they can all be assembled from some or all of the following standard parts but the neces-



sary special fixture, bushing plates and the like parts peculiar to the particular part they are processing would, in most cases, have to be special. The basic machine components are: base, legs or pedestal, index table and dial support, an index table itself, a plain vertical column, a tunnel column, a drill unit, which with the addition of multiple spindle heads or tapping attachments, etc. can be used for a number of purposes, *Fig.* 3.

Specials From Standard Parts

There exists a type of "special machine" that can be built from a number of the same components, the only special part of the machine design being the arrangement of these parts and usually, the fixture that holds the part. In some cases, the machines made of standard components will produce a part just as economically as the completely special machine. No general rule can be given for selecting parts that can be economically produced on these building block machines—each one must be studied individually.

The use of building block machines offers cost and time saving advantages to many types of manufacturers. To the subcontractor making parts for other companies' products, it offers an economic advantage over his competitor in that the total cost of the building block machine does not have to be paid for by a single job, since on completion of a contract run, the same basic parts can be used to build another machine to process another part. Only the cost of the special fixture and other special portions of the machine, if any, the cost of assembling the machine and a small portion of the cost of the standard parts of the machine need be charged against the specific part being manufactured.

To the manufacturer producing a proprietary product in quantities too small to justify special purpose machines, the lower cost of building block machines brings the special purpose machine within his economic reach. In many cases, available standard components will enable him to build his own machines.

Another group of manufacturers to which standard component equipment is of interest is the group whose product is undergoing rapid technological change and the manufacturer is therefore plagued with frequent product design changes requiring deletion, addition, and modification of operations in the manufacturing process. Changes to existing equipment are facilitated by the use of building block equipment particularly if the machine was originally laid out with the possibility of subsequent modifications in mind.

If Temporary Units Are Needed

To the high or continuous run manufacturer, the building block machines are of the least interest because minute savings in the individual piece time will result in large annual savings and economically justify very special machines. Furthermore, the adjustability found in certain components of building block machines is a disadvantage in that the process engineers lose control over feed and speed rates, length of a tool's quick advance and other factors affecting the cycle time. Making it possible for the operator and other personnel to tamper with or adjust the machine is a serious disadvantage to the large volume producer. Yet, there often is an application for building block machines here. At times, due to one or more of a number of circumstances, the large volume manufacturer is faced with the problem of producing a particular part in substantial quantity on temporary equipment for a period of time until special equipment can be procured. In some cases, it would appear that temporary equipment could be built from standard building blocks to advantage.

It is not my intent to suggest that all special machines could or should be made from standard components, but a review of existing special machines will reveal that many of them could be built with the same basic parts, to some financial advantage. This is believed to be true in all but the smallest volume type of production.

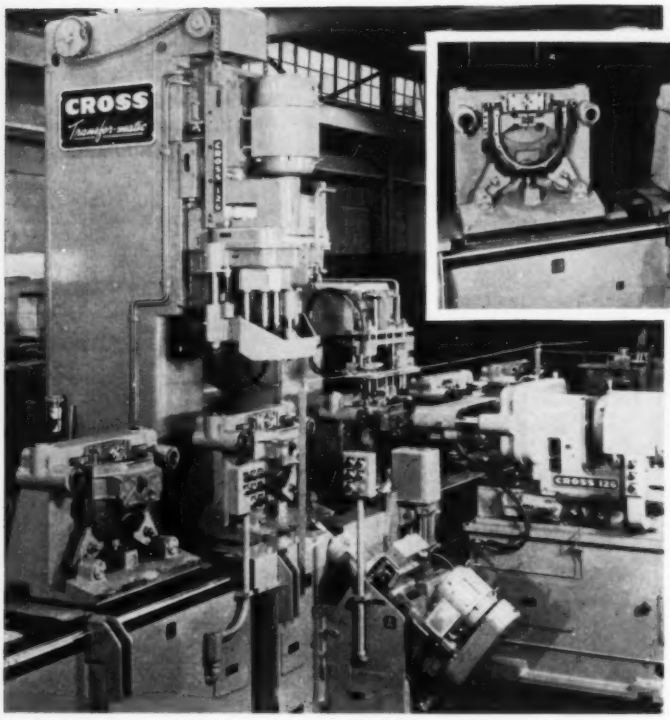


Fig. 1—Transfer machine tooled to handle two different workpieces. Insert shows a flywheel housing in the pallet fixture on the right and a converter housing in the fixture on the left. Work station has probe to electrically signal which part is in the fixture so that slide unit will either come forward or return to standby position.

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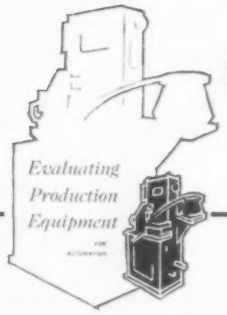


SOLVING AUTOMATION PROBLEMS WITH TRANSFER MACHINES

An approach to automation is the technique of using transfer machines to solve the production problem. Transfer machines have reached a high state of development and today offer outstanding possibilities.

TRANSFER MACHINES have been applied to an endless list of products and operations. For this discussion, the following applications have been selected to indicate the outstanding possibilities and the high state of development of transfer machines: (1) Transfer-matic for more than one work piece—flywheel housings and converter housings. (2) Automatic banking for increased efficiency—cylinder heads. (3) Precision boring in transfer machines—differential gear cases. (4) Automatic assembly machines—cylinder head assembly.

Multiworkpiece Transfer-matic

Similar parts can be machined on a transfer machine without disturbing the setup of the machine. On the right, in *Fig.* 1 insert, is a flywheel housing which is used to couple a standard synchromesh-type transmission to a V-8 engine; on the left is a converter housing, used to attach an automatic transmission to a V-8 engine.

The engine mounting faces of either part are alike; however, the transmission mounting faces are entirely different. The front, rear and bottom faces of the parts are ground prior to moving to the Transfer-matic, which completes the balance of the operations.

The Transfer-matic for flywheel and converter housings is shown in *Fig.* 1. The operator can place either part in the fixture with random selection of the work piece. Common tooling is provided for the engine mounting face; individual tooling is provided for the transmission mounting faces. As the work piece progresses through the machine, proper tools are selected automatically.

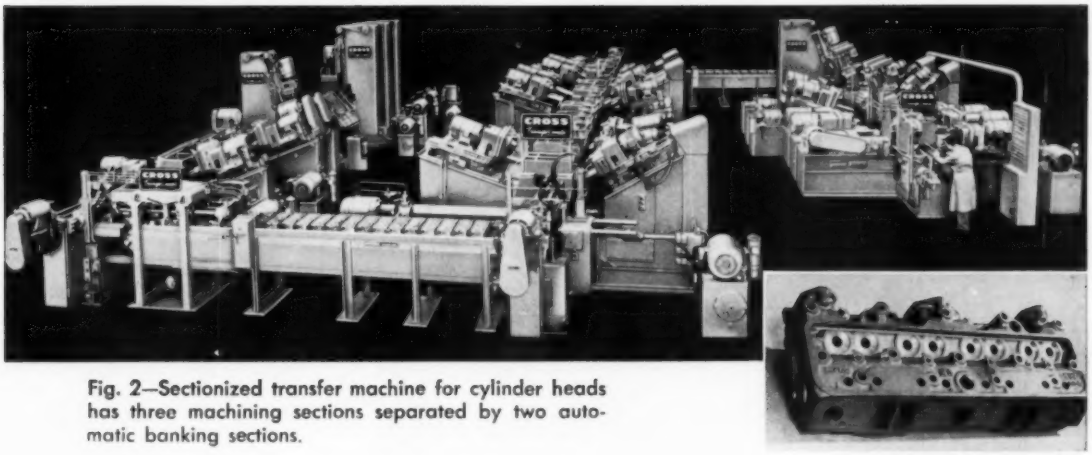


Fig. 2—Sectionized transfer machine for cylinder heads has three machining sections separated by two automatic banking sections.

In *Fig.* 1, on the right, the work pieces are shown as they are held in the pallet work holding fixtures. All fixtures accept either work piece. The picture to the left, in *Fig.* 1, shows a station with the actuating plunger which selects the tools.

Since the contour of the flywheel housing and the converter housing are different, the actuating plunger can differentiate between the two and, thereby, electrically indicate whether the slide unit should continue forward to machine the part, or return to standby position.

The advantages of this technique are: (1) Economic justification of transfer equipment. (2) Provisions for changes in production schedules. (3) Continuous flow of either work piece. (4) Reduction in labor cost by elimination of setup changeovers.

▶ Sectionized Automation with Banking

For machining 461 operations on cylinder heads, *Fig.* 2, Sectionized Transfer-matic was created to reduce down time with the first application of automatic banking.

The key to the increased operating efficiency of this machine is its division into three sections and the use of two banking units—one at the rear between section I and section II, and the other in the front between section II and section III.

If production is interrupted in section I for tool changing or maintenance, sections II and III continue to operate as they receive parts from the two banking units. If section II is stopped, the first banking unit stores the overflow from section I, and the second unit continues to feed section III. If work in section III is interrupted, the second banking unit receives and stores the parts from sections I and II. The ability to shut down any one of the sections while the others continue to operate results in greatly increased production efficiency. The rated production capacity is 144 cylinder heads per hour at 100 per cent efficiency.

The machine completes all operations except broaching. There are: 213 operations in 11 stations

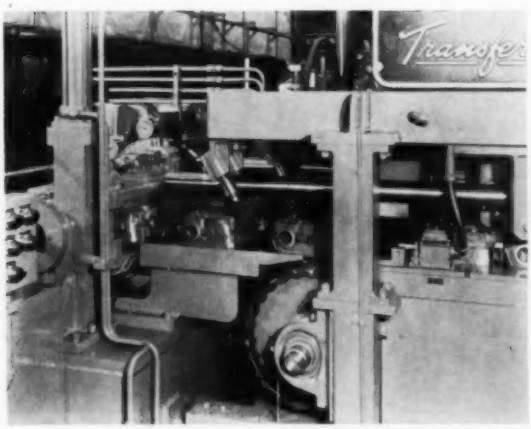


Fig. 3—Transfer mechanism moves cylinder heads out of storage bank into turnover fixture at the start of second section.

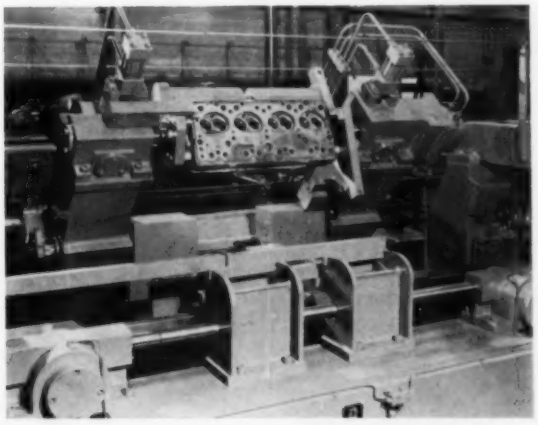


Fig. 4—Automatic turnover mechanism is hydraulically operated and electrically interlocked.

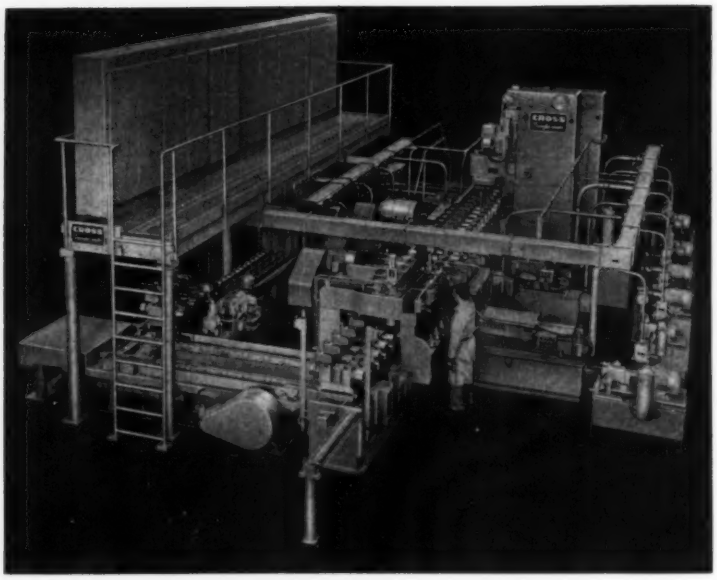


Fig. 5—Chucking type transfer machine does precision boring on differential gear cases.

of section I, 154 operations in 16 stations in section II, 94 operations in 13 stations in section III.

The method of operation of the automatic banking section is such that a chain roller conveyor carries and stores the cylinder heads. The conveyor is continually moving. In *Fig.* 3 the transfer bar is moving a cylinder head into the empty turnover fixture, which is the first station of section II.

The cylinder heads are automatically turned over with an automatic mechanism, *Fig.* 4, which is hydraulically operated and electrically interlocked.

▶ Chucking Transfer-matic

Precision boring is generally accomplished on standard precision boring machines or special boring machines. In either case, the workpieces must be handled several times to accomplish multiple operations. The Cross Chucking Transfermatic, for machining differential gear cases, *Fig.* 5, is a new development. It is the first chucker ever built on this principle.

This equipment was created to precision bore, face, generate the internal radius, and machine the pinion pin holes on differential gear cases which rotate on precision spindles. Concentricity is assured.

This machine has an unusual feature—that is, the workpieces are chucked and not released until all operations are complete. The chucks are mounted on precision spindles which, in turn, are carried on pallets, four to a pallet. There is a pallet for each of ten stations, and three pallets

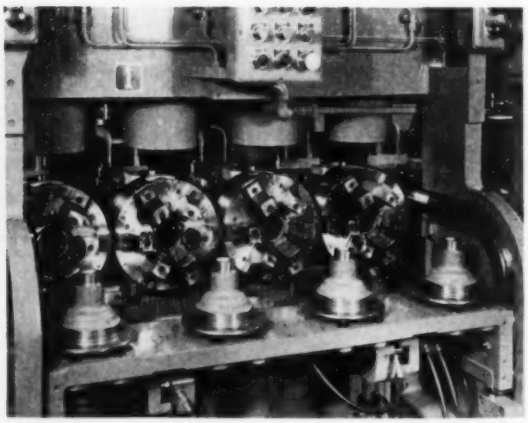


Fig. 6—Close view of loading station shows prepositioning table in front of four pallet-mounted chucks that are opened and closed by power wrenches above.

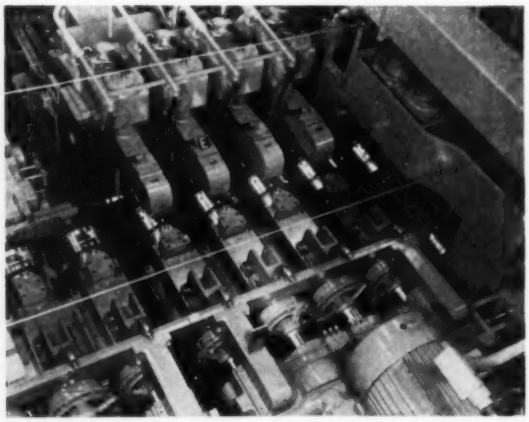


Fig. 7—Tool slides at boring station are aligned with each chuck by limit switch contact of a locating button on the chuck centerline.

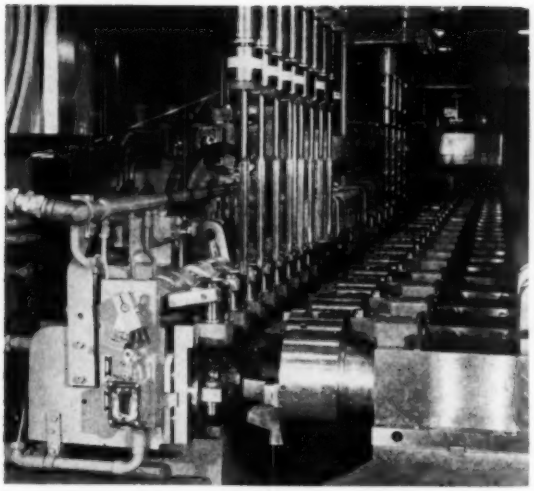


Fig. 8—Drilling, chamfering, rough reaming and finish reaming are accomplished with the chucks locked in oriented position.

on the conveyor moving from the last station back to the loading station. The rated capacity is 368 pieces per hour at 100 per cent efficiency. Standard Cross "building block" construction makes provisions for any reasonable number of stations and workpieces up to 48" in diameter.

In *Fig.* 5 the operator is shown at the loading station where four parts per cycle are set on the loading mechanism, which indexes into loading position, holding the workpiece while the chucks automatically clamp. A close-up view, *Fig.* 6, of the loading stations shows the power wrenches used to unclamp and clamp the work piece.

When more than one fixture must be brought in line with a tool, precision boring becomes a problem. However, the electronic tool positioner, *Fig.* 7, developed for station 2 of this machine, can maintain a total bore size tolerance of less than 0.001-inch on the diameter.

Each spindle has a precision button, ground relative to the center line of its spindle. A limit switch, carried on the tool slide, contacts this button and positions the tool. There are four individual tool slides in this station, one for each spindle.

After the precision boring operation each pallet is transferred to station 3 where spherical seats are generated, and then to station 4 where the flange faces and thrust faces are machined. As the pallet is transferred from station 4 to station 5, the spindles are oriented and locked to prevent rotation for machining the pinion shaft pin hole.

At station 5 the pin hole for the pinion shaft is drilled. In *Fig.* 8 stations 5, 6 and 7 are shown. At station 6 the pin hole is chamfered at the top and bottom. At station 7 the pin hole is rough reamed and finish reamed with a shuttle type head. The finish reamed pin hole must be machined within plus or minus 0.001-inch relative to the flange face and the gear pocket. To accomplish this, each bushing plate locates in the gear pocket and on the flange face of the work piece to be reamed.

▶ Automatic Assembly

The most revolutionary installation of transfer machines has been the automatic final assembly line. The engine assembly line is 565 feet long, and the cylinder head lines are each 120 feet long. *Fig.* 9 shows a cylinder head assembly line as installed.

This equipment was designed to satisfy several conditions: (1) To achieve a uniform, specific

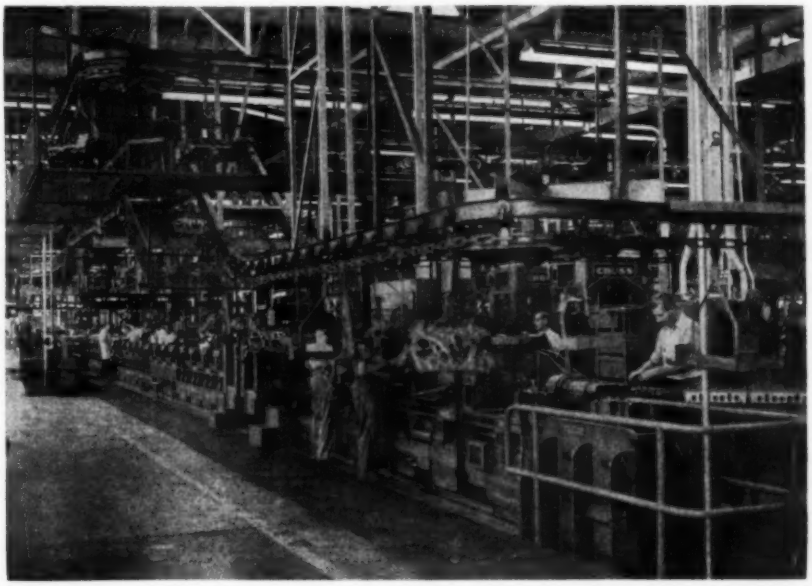


Fig. 9—Transfer machine for automated cylinder head assembly operations.

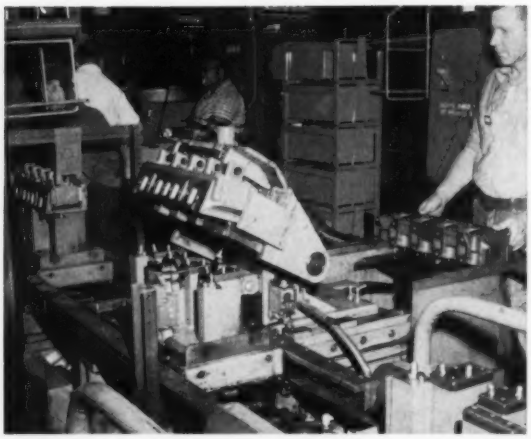


Fig. 10—After valves are manually installed, turnover fixture places cylinder heads on first station of transfer machine.

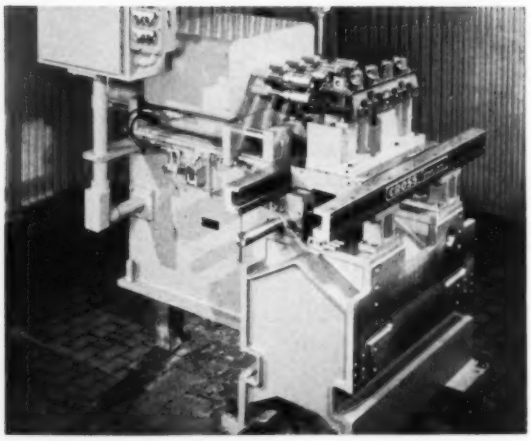


Fig. 13—Modular construction of units for the transfer machine provides standardization and flexibility to add or revise automated stations.

Fig. 11—Automatic equipment depresses valve springs, and installs valve keepers. Station at right works on exhaust valves—station at left handles intake valves.

Fig. 12—Unit turns exhaust valve studs to specified torque.

torque on all bolts and nuts automatically. (2) To eliminate human failure. (3) To reduce operator fatigue. (4) To provide modular construction for future additions of newly automated operations. (5) To gain a higher quality product.

The first operation is the manual installation of the valves. The cylinder head is then automatically turned over, *Fig.* 10.

After the valve springs and valve washers are manually assembled, the springs are automatically depressed, *Fig.* 11, and the valve keepers are automatically assembled. Spark plugs are automatically tightened and torqued at a subsequent station. Small parts needed for a single cylinder head assembly are brought to the line in a plastic tray. The trays are automatically filled on a separate transfer line.

Exhaust manifold studs, *Fig.* 12, are brought to a specified torque. After manual assembly of the exhaust manifold, the exhaust nuts are tightened and torqued at another automated station in the line.

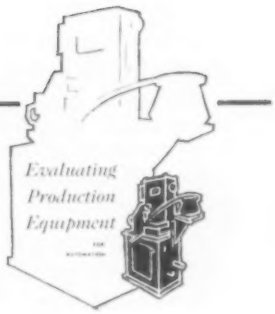
Pallets are attached to a chain and return to the beginning of the line through a tunnel beneath the machine base. The pallets are located in each station with shot pins. The transfer of the pallets from station to station has a uniform acceleration and deceleration for operator safety. The dwell time in each station is sixteen seconds.

Modular construction, *Fig.* 13, permits removing any section in the line without disturbing the transfer mechanism. Should the sequence of operations be altered, the sections can readily be moved. Each base section has a machined surface on both sides of the base to provide the addition of newly automated operations.

There is no set formula to determine when a transfer machine is justified. Each requirement must be analyzed individually. Most important is an analysis with an optimistic determination to improve past procedures.

DEVELOPING

SPECIAL PURPOSE LINES



It is possible to develop completely special-purpose production equipment from the ground up. This is often the only answer for very high production with products of new or unusual character or where complete processing from raw materials to finished product is necessary.

By **ROBERT SATTLER** Vice President, LaSalle Tool Co., Detroit, Mich.

WHEN YOU HAVE high production on parts and the operations vary from drilling and milling to air testing and assembling, a special machine is in order. If we consider the modern manufacturing plants which are designed around the machinery and equipment necessary to produce a specific product, such as an engine or gears and axles, we find that the plant itself resembles a special machine. From door to door and from floor to ceiling only that building that is necessary to allow the material to flow from station to station, so to speak, is provided. Raw material is received on one side and finished products shipped out the other side. Qualifying, machining, gaging, heat treating, painting, assembling and testing are done in-line with stockpiling reduced as much as possible. Scrap systems and coolant systems are also specially designed to reduce the required floor space of the plant.

When machines are considered in planning plants, they must be machines that move the parts from the front door to the back door in a straight line. The machines must perform the necessary operations, tests and assembly in the least possible space with a minimum of manpower. In order to reduce the number of machines, operations have to be combined where practical. Unit cost on products must be kept down so only that floor space that is necessary, only those machines that are required, and only that labor that is necessary is used.

With the tax conditions of today you must either utilize every piece of equipment and every square foot of floor space to its fullest extent or get rid of it. This means that in mass production you not only benefit from special machines in floor space required and more pieces per hour, but you are able to write off special machines in less time than stanard machines doing the same operation.

We at LaSalle have been manufacturing special tooling and machinery since 1928 and consequently have a vast amount of experience to draw from; however, we find that to stay ahead in our business we must constantly look for better ways of building machines. There is a continuous flow of new metals, instruments and developments that we must keep up with so that in analyzing a job we can come up with better ways to perform operations.

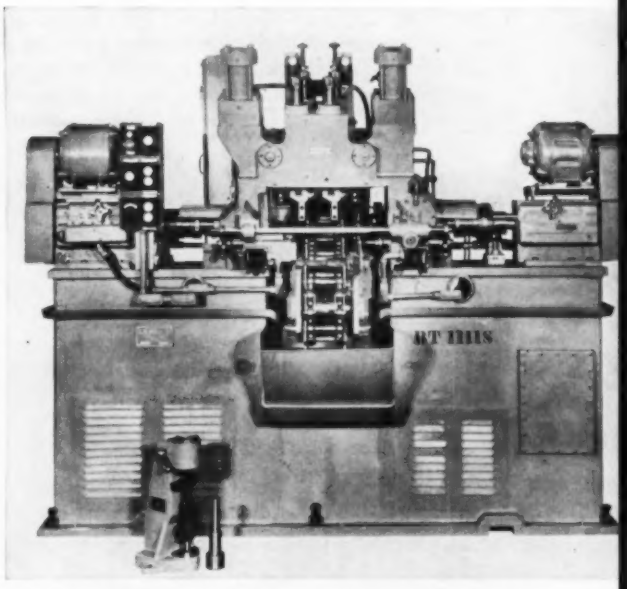


Fig. 1—In 1948 this machine was developed to automatically center drill both ends of two styles of automotive pinion blanks which varied in diameter only.

You have only to look over your shoulder and you can recall many of the past trade names that have fallen by the wayside, out-produced and out-

sold by newer and better methods.

The designing of a special purpose machine takes time. Naturally, we use proved methods and standard units wherever practical, but we will not slight the following considerations just to use a standard unit:

1. The operator's safety
2. Accessibility for maintenance or tool change
3. Chip clearance
4. Cycle time

To satisfy these conditions we must often resort to different ways of performing an operation, and sometimes when an operation is being considered that has never been done before we must build setups and experiment until we find a satisfactory way of performing the operation. Someone must get there first, and both the builder and the user by so doing stay one step ahead. We might add here that the special purpose machines and lines of today are the recognized standards of tomorrow.

In order to design and build a special automatic machine or line you must consider each of the following:

1. Loading, positioning and qualifying the part
2. Moving part to work station
3. Locating and clamping part
4. Performing required operation
5. Unclamping
6. Moving part to gage station
7. Checking operation with classifying and/or feed back of information
8. Unloading (good or reject)

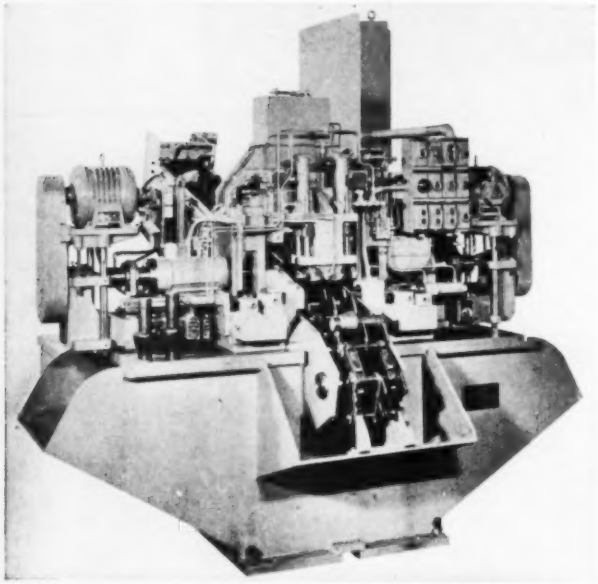


Fig. 2—Developed to improve on its predecessor, this 1954 machine automatically center drills an assortment of pinion blanks varying in diameter and length. No change of machine settings or controls is necessary to accommodate different workpieces.

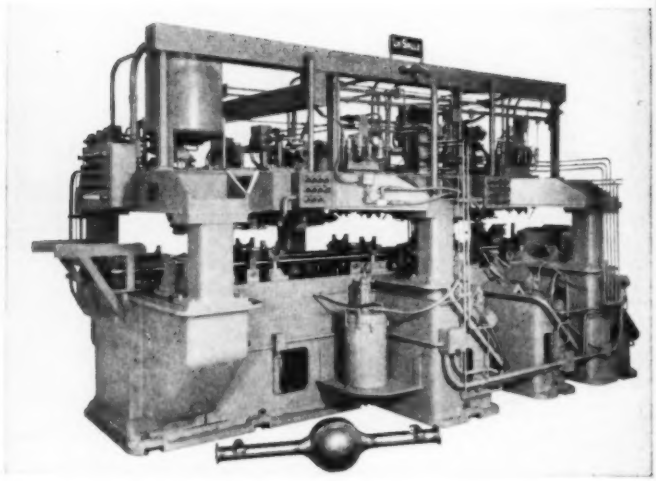


Fig. 3—Three styles of rear axle housings are processed automatically on this 1956 machine which forms drain and vent holes and feeds and runs a pipe plug.

Which is the most important? They are all necessary; therefore, they are all important and consideration must be given each one in relation to the rest.

Which one cannot be altered? Within reason—"the operation to be performed"; it will require a given time to give best results.

We will concede that a given time is required to perform an operation, but we will not be subjected to the conventional method of performing this operation.

In order to produce more pieces the time required must be kept to a minimum for every motion: (a) Moving of part, (b) locating and clamping part, (c) rapid approach of unit, (d) rapid return of unit, and (e) unclamping part.

Three specific case histories illustrate the use of special machines developed from the ground up.

The first illustration, *Fig.* 1, was a 1948 General Motors development to center drill both ends of two hypoid pinions which vary in diameter only. Operation steps are: Automatic load, automatic transfer, automatic clamp in equalizing Vee's, automatic center drill, automatic unclamp, automatic gage and automatic unload. The parts were broached both ends in a previous operation and the broach operator placed the pinion on the load chute track. The pinion entered a device which initiated the machine cycle and placed the part on the chain conveyor. The chain conveyor was moved by a hydraulic cylinder in intermittent motions. If a part was present at the station

prior to the centering station, it tripped a limit switch which initiated the centering unit's cycle. If a part was not present the units would not cycle. After the part had been centered it was gaged at the next station. Here the depth was checked and a broken drill could be detected. Then the parts were automatically unloaded onto a conveyor belt.

By 1954 the pinions were changing. The head diameters varied and the lengths varied up to 1½ inches. In place of three separate special machines, three standard centering machines could do the job; but production was not divided evenly and the operators would have to keep changing setups or the pinions would have to run in batches. *Fig.* 2 shows the pinion centering machine that was purchased to do this job. The machine can automatically load, position, locate, clamp, center drill, gage and unload pinions at the rate of 220 pieces per hour; and it can automatically handle any of the pinions in any order without changing so much as a selector switch.

A second illustration is the 1956 Ford Motor machine to perform the following operations on Ford, Mercury and station wagon rear axle housings: (a) Pierce and extrude drain hole, (b) tap drain hole, (c) apply Permatex to drain hole, (d) feed and run ⅜-inch pipe plug into drain hole, (e) drill vent hole, (f) probe and burr vent hole, (g) tap vent hole, and (h) turn part over.

The machine, *Fig.* 3, is automatically loaded and the location and clamping is arranged so that either the Ford, Mercury or station wagon rear axle housing can be run without changing a thing. The part is a welded assembly with no previous machining; therefore, the locating and clamping has to repeat from rough surfaces. The part is conveyed on shuttle bars, then lifted up into each fixture.

The fixtures are mounted in the crown plate and the locating surfaces are all face down, which makes it almost impossible for chips or dirt to hinder location. The machine is completely automatic and produces 225 axle housings per hour.

The third case history covers 1956 piston manufacturing machines for Chrysler and General Motors. Piston manufacturing demands high production and accuracy in a competitive market so that special purpose lines are a *must*.

Pistons vary a great deal in design, which in turn necessitates a great flexibility in the method of handling them. The head of the piston may have a dome, may be flat, concave or irregular. It may also have valve clearance cast or machined in it; and it may or may not employ a center boss. The piston may have oil return slots or holes, and it may have a full skirt, slipper type or partial skirt. Pistons probably have had more patents pending than any other part of the engine. Operations range from milling off gates and risers with a 1/16-inch tolerance to precision boring with a tolerance of 0.2 to 0.001-inch.

In arriving at our method for handling pistons we have taken the above facts into account. We do not slide the pistons, we do not roll the pistons, we do not bump the pistons. Further, if you can specify diameter variations (for instance 3 to 4½ inches) we can design the mechanism to adjust to handle any piston in the range. Likewise, if you can specify overall length (for instance from 3 to 5 inches) this can also be taken into consideration.

A machine that alternates between production of Buick, Pontiac, Cadillac or Oldsmobile pistons by merely turning two selector switches and changing some locators is shown in *Fig.* 4. This machine is a combination dial and in-line machine. Of special interest is the transfer unit that takes the piston from the index table and places it on

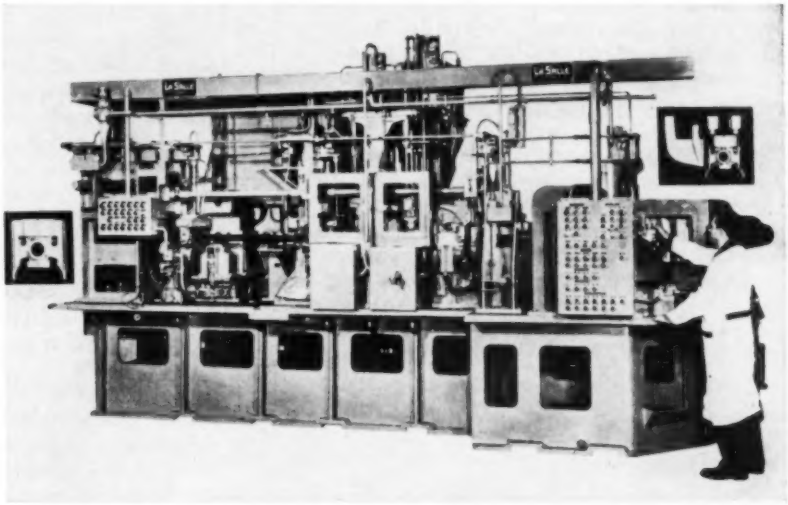


Fig. 4—Machining of pistons for four different automobiles is possible on this machine by merely turning two selector switches and changing some locators. This unit includes dial and in-line sections.

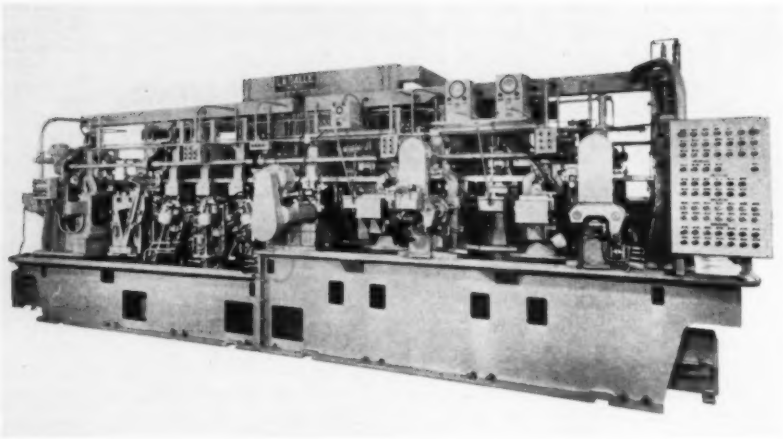


Fig. 5—Automatic gages stop this piston machine at the completion of a cycle if wrist pin holes are outside limits.

the load station of the in-line part of the machine. At Station 8 the piston OD is hollow milled in 1.50 seconds. At Station 10 the skirt end of the piston is faced and chamfered. This head is driven by a fluid motor.

A Sheffield Plunjet gage is used to measure the OD of the piston and to classify the piston into one of five sizes. This information is relayed to the weight scale at Station 12. If the piston is oversize or undersize, it is not weighed at Station 12, but passes through and is rejected at Station 13 as oversize or undersize. The weight scale at Station 12 compensates for diameter variation indicated by the gage when it weighs the piston and registers as overweight, underweight or O.K.

The second piston machine, *Fig.* 5, includes the following stations: (1) Load and position, (2) rough bore and chamfer wrist pin holes both sides, (3) check wrist pin hole both sides, with air gages, (if either oversize or undersize, the gage automatically indicates the situation and stops the machine at the completion of the cycle), (4) idle (accessibility), (5) machine snap ring grooves both sides, (6) air gages check the snap ring grooves, (7) idle (accessibility), (8) saw two slots in oil ring groove, (9) idle (accessibility), (10) mill valve clearance in the head of the piston, (11) remove center boss from head of piston, (12) mill valve clearance in the head of piston, (13) idle (shuttle mechanism), (14) idle (shuttle mechanism), (15) brush valve clearances to remove burr, and (16) unload.

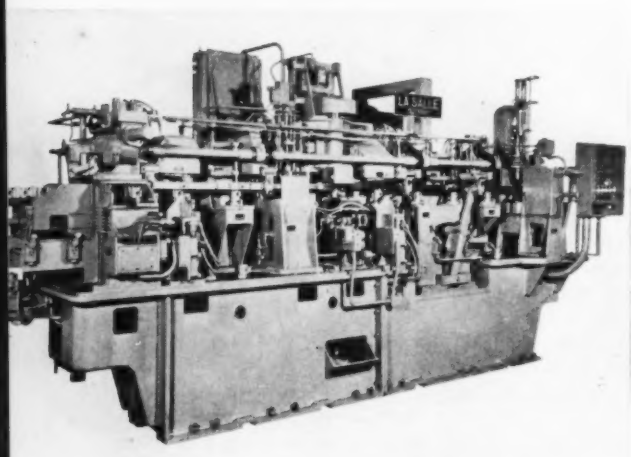


Fig. 6—This piston machine automatically mills pistons for weight correction and classifies its own production by a 100 per cent reweigh.

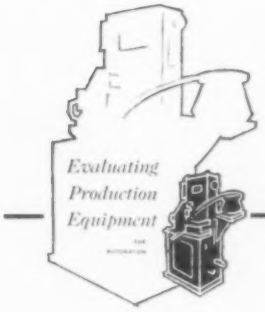
The third piston machine, *Fig.* 6, performs the following operations: (1) Load and position, (2) idle (shuttle mechanism), (3) idle (shuttle mechanism), (4) idle (shuttle mechanism), (5) weigh piston and record weight, (6) mill piston to weight, (7) blow out, (8) idle (accessibility), (9) reweigh (checks production 100 per cent and setup distribution at the unload station), and (10) unload (Perfect pistons move forward at unload station; overweight pistons move to the left on a side track at right angles to the main track; underweight pistons move to the right on a side track at right angles to the main track). Pistons are produced at the rate of 400 per hour, and accuracy on the balancing machine is within plus or minus 1 gram.

The machines described were designed from the ground up and work on the average of 16 hours a day and five or six days a week. They are automatic and very unconventional. They have only that machinery built into them that is necessary to do the job; therefore, the cost is only that investment necessary to do the job. They do not employ platens which restrict the number of operations that can be performed. They do have fixtures at each station which suit the operation to be performed. Floor space required is at a minimum. They illustrate what we at LaSalle believe—that in order to produce high production products at a minimum cost you must keep capital investment down, floor space at a minimum and labor to a minimum. The special purpose line is often the only answer.

Special punched plastic tape is used to control positioning table manufactured by Jones & Lamson Machine Co. Column of signal lights, aligned with setup sheet mounted on controls, informs the operator what to do at a given location.

By J. H. McRAINEY
Associate Editor

SHORT RUNS AND JOB LOTS WITH

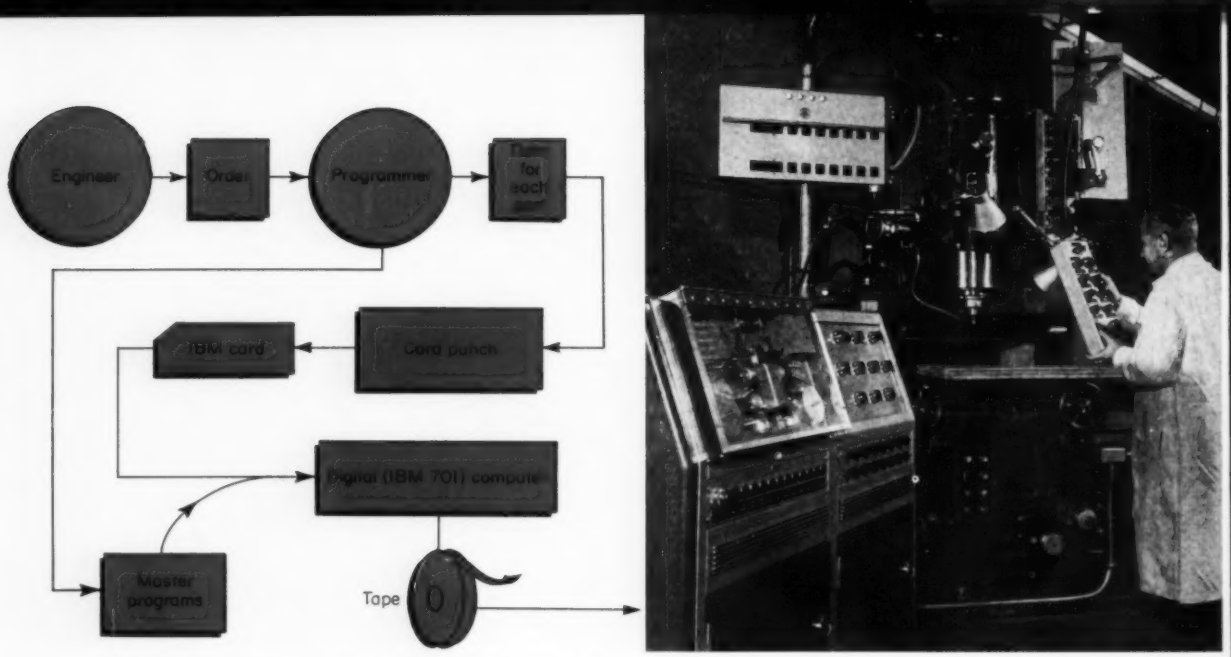


TAPE AND CARD CONTROLLED MACHINES

In machine tool control, advancements have been made which place general purpose machine tools right in the midst of automation developments. The advancements are based on numerical control techniques. This article presents a general picture of the status of numerical control as a guide to designers and users concerned with short runs and job lot operations.

ALWAYS a time for careful consideration, the purchasing of a general purpose machine tool calls for even more discrimination today. A new and important factor must be added to the points to be considered before buying—whether or not to specify numerical control. As generally understood, the term *numerical control* refers to that form of control for automatic systems in which the input consists of mathematical data. It refers more to a philosophy of control rather than to a definite system and a variety of systems for general purpose machines have been, and are being, developed. There are considerable differences between the various systems.

However, in the broadest terms, numerical control systems for machine tools are similar in that each must provide: (1) a system for translating information about a desired part into mathematical data which can be stored on some medium; (2) equipment on the production floor capable of reading and following the instructions stored on the medium; (3) a machine tool whose operations can be electrically controlled; and (4) an independent feedback system which monitors the machine actions and introduces correction factors into the control system when required. Beyond these points, the only other generalization which can safely be made is that numerical control systems



Data preparation system for Autonetics' two-dimensional contouring control system results in magnetic tape which controls miller in production of templates. Control system can be applied to other kinds of machine tools such as lathes and boring mills.

vary in complexity, depending on the functions and operations of the machine tool being controlled.

But whatever the technical differences, stated results with the application of numerical control in all cases are similar and impressive: faster production cycles, more consistent accuracy and reduced setup time. These are results which lead to improved productivity and quality, lower manufacturing costs, and smaller economical lots. These are considerations of interest to all manufacturers, but, in that numerical control applies to the use of general purpose machines, they are of special interest to the job shop type of operation. It is this fact which has created so much general interest in numerical control and which has spurred its development to the point where today the equipment purchaser is faced with the decision to use or not to use numerical control.

▶ Some Misconceptions

Since systems are designed for special functions, a detailed discussion of the variety of technical differences would serve little purpose. Some points require clarification, however. In the presence of extensive writings and discussion of numerical control, but in the absence of an extensive background of operating experience, a variety of opinions on the subject have been formed. All of the opinions are not correct. For instance, to some people numerical control is synonymous with skin or spar milling—a situation which reflects the immediate historical background of the art.

The same pioneering instinct among defense planners which led to such things as Project Tinkertoy, also culminated in the demonstration in 1952 of a numerically controlled machine tool. Under an Air Force development subcontract, M.I.T. had succeeded in applying a numerical control system to a Cincinnati Hydrotel milling machine. It is considered to be one of the most significant of the pioneering efforts in numerical control. Regardless of the shortcomings of the M.I.T. system, it proved that a numerical control system could accurately control a machine.

To firms such as Giddings & Lewis and the General Electric Co. which had experience with electric tracer control and record playback control, the M.I.T. developments were of immediate interest. Further work at M.I.T. and within the two companies resulted in the pioneer multi-axis Giddings & Lewis Numericord system. Demonstrated in 1955 on a spar and skin milling machine, the system has been logging actual production floor experience in aircraft work ever since. The Numericord system is relatively complex: five machine axes and 22 auxiliary machine functions can be completely programmed and controlled. If any doubt had existed previously as to the technical feasibility of numerical control, it was now dispelled.

The development of other numerical control systems proved to be successful. Subsequently, the government reviewed outstanding orders for an extensive Air Force machine tool purchase program that included a large number of tracer controlled machines for special milling applications. Some adjustments were made and today, there are over 140 machines on order in the skin and profile mill category which will be numerically controlled.[1]

[1]References are tabulated at end of article.

In an apparent attempt to advance the art, the government has spread the orders among four different control systems. The four systems are not compatible so far as control media and data preparation requirements are concerned. This is a cause of some concern to the intended recipients of the machine tools. This concern has led to a very active study and discussion of the relative merits of the various forms of control for skin and spar milling machines. Interest is focused upon spar and skin milling machines in particular because they will be the first delivered and it is felt that gains in compatibility which can be made in the area of complex types of numerical control will automatically influence the simpler forms. At any rate, the overall effect is a very close association of numerical control and spar and skin milling machines.

It would be a mistake to erroneously identify the cause of this effect in reaching a hasty judgment about numerical control. It is not simply that aircraft parts are being made, but rather that in the aircraft industry there are requirements for varieties of complex parts, in relatively small quantities, subject to frequent design changes, which must be made faster at increased accuracy for a lower cost. How many machine shops are there that don't have similar requirements to one degree or another?

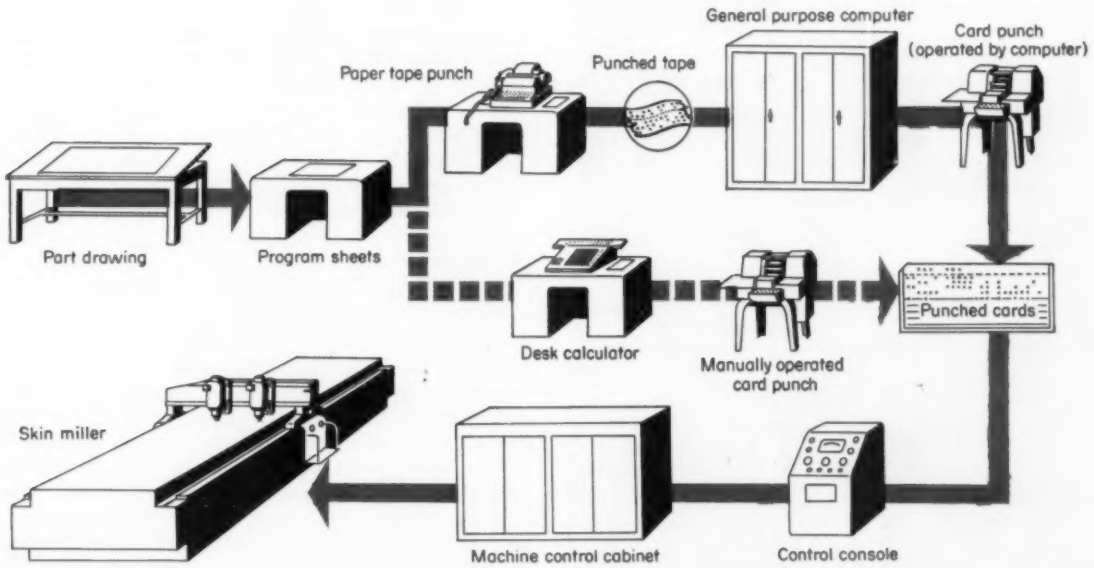
▶ Competes With Other Controls

Some people cannot understand why there is not a wholesale stampede to adopt numerical control if "it is so darned good", and in the absence of such a movement, the feeling of "I'll wait and see" is engendered.

Numerical control of machine tools cannot be divorced from the historical background of the machine tool industry. Within the last 10 years, evolution has led to simultaneous improvements in coolants, mechanisms, materials, tools, tooling, gaging, work handling and controls. Superimposed on these improvements related to individual machines have been additional changes within the industry arising out of new concepts of mounting complex arrangements of single-purpose tools. When focused at the point metal is being cut, the cumulative effect of these improvements appears to be revolutionary. Especially is this true when it is recalled that recent surveys indicate that approximately 60 per cent of machine tools now in operation are at least 10 years old. Industry simply does not digest developments as rapidly as developments are made.

It is within this general framework that numerical control has come into prominence—a prima donna among more conventional improvements in feed, speed and sequence control. Viewed from this standpoint, numerical control must compete not only with the way things are now being done, but also with improved conventional methods not yet exploited. This might bring the competition between the horse and the automobile to mind, but the correct simile would be the competition between the automobile and the helicopter.

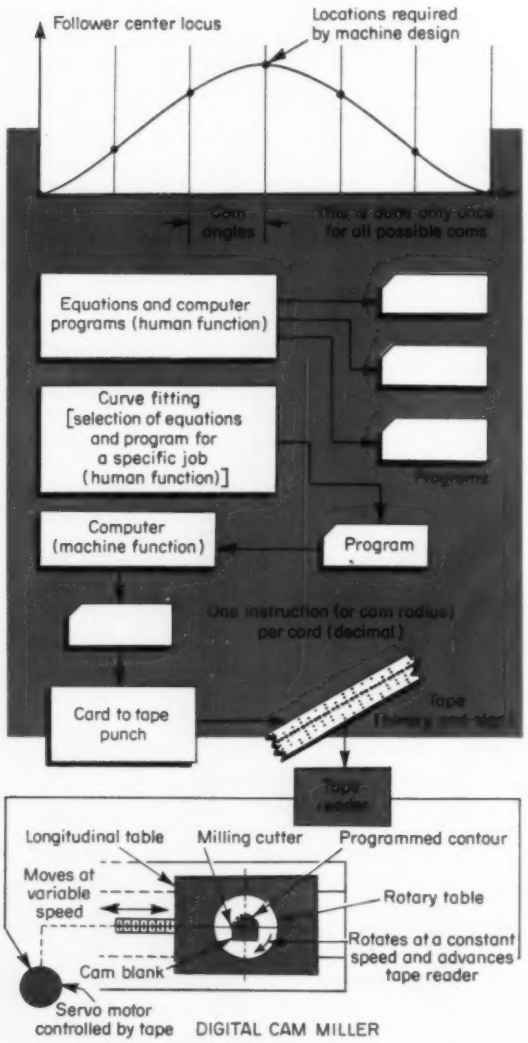
This competition which numerical control faces does not exist to the same degree in all applications, however. In machining of certain types of complex work such as cams, dies, integrally stiffened aircraft parts, etc., there is considerable



Example of data preparation flow for three-dimensional contouring control system in which input to machine tool control is a perforated medium. This system by Cincinnati Milling Machine Co. provides for either machine or manual computations.

agreement as to the advantages of numerical control equipment. In these cases the competition really exists between numerical control and tracer control, and both are relatively expensive and complex. Developments have proceeded to the point where large machines equipped with numerical control are slightly less costly than the same machine equipped with certain types of tracer control.[1]

At the other end of the scale where simpler numerical control is primarily used to position work accurately for drilling or punching, it is essentially in competition with the expensive and time-consuming job of manual layout or jig preparation. Shops with repetitive operations of this nature have no problem in justifying the use of numerical control positioning tables.


Follower center locus
Locations required by machine design
Cam angles
This is done only once for all possible cams
Equations and computer programs (human function)
Curve fitting [selection of equations and program for a specific job (human function)]
Computer (machine function)
Program
One instruction (or cam radius) per card (decimal)
Card to tape punch
Tape
Tape reader
Longitudinal table
Milling cutter
Programmed contour
Moves at variable speed
Rotary table
Rotates at a constant speed and advances tape reader
Cam blank
Servo motor controlled by tape
DIGITAL CAM MILLER

Unique contouring system developed by IBM Corp. for preparation of two-dimensional master cams. Profile of cam is generated during one revolution of rotary table.

There remains the broader middle ground where the main competition with conventional controls exists. The prevalence of the "wait and see" philosophy is thus understandable. However, to say that there is a general area where competition exists is not to say that both forms of control are equal in a particular situation. Only detailed investigation can provide the facts on which to make a decision. In short, the proponents of numerical control say that five years ago "wait and see" might have been an acceptable overall approach for a potential user to take. Today, the time for "waiting" has passed and the time for "seeing" has arrived. It is in attempting to follow this advice that the potential user runs afoul of the controversies within the industries most closely allied to the field.

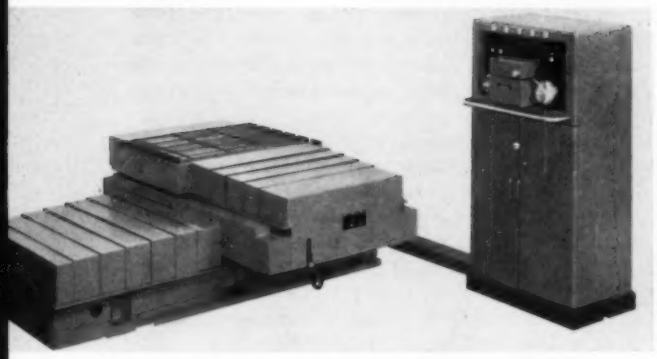
▶ Variety of Systems

Necessarily, a variety of industries have contributed to the techniques employed by a numerical control system, the major ones being data processing, control, and machine tool. One report states, "There are now about 350 companies doing development work in this field and/or the associated data processing."[1] It is not surprising that numerical control systems differ, but it is unfortunate that they differ to such extremes that the average user can easily believe that his best course of action is to wait for the industry to settle down.

Systems naturally differ because of the basic machine function. Among the other differences there is the variation in information form: some depend upon analog, other digital techniques. There is a great deal of difference in the means of storing control data: punched cards, various types of punched tapes, and magnetic tape being the three most prominent. Another area of major difference is in the method of coding or recording data: decimal, binary, binary decimal, reflected binary, voltage amplitude, frequency or phase, pulse height, pulse width, etc. are represenative of the types. The feedback element can use either analog or digital techniques and can be either rotary or linear in operation. The overall control system can be characterized by high speed and low accuracy or low speed and high accuracy.

Without considering cost, so long as the equipment meets operational and maintenance standards, some of the differences in the various systems are of no consequence to the user. However, depending upon the type and range of equipment necessary to the user's business, other differences are of major concern and deserve some discussion.

The data preparation phase is such an area. This phase is wholly concerned with data processing techniques, including encoding, computation and data storage. For all but the simplest forms, it is this phase of numerical control that will have a radical effect upon the existing plant organization. By some means the user must bring together and co-ordinate the functions of the designer,



Punched tape controlled work positioning table manufactured by Arter Grinding Machine Co. Tape positions work under a machine tool such as a radial drill. Written instructions on tape tell operator what to do at each position. Tape is unreeled from inside of coil, never requiring rewinding for use.

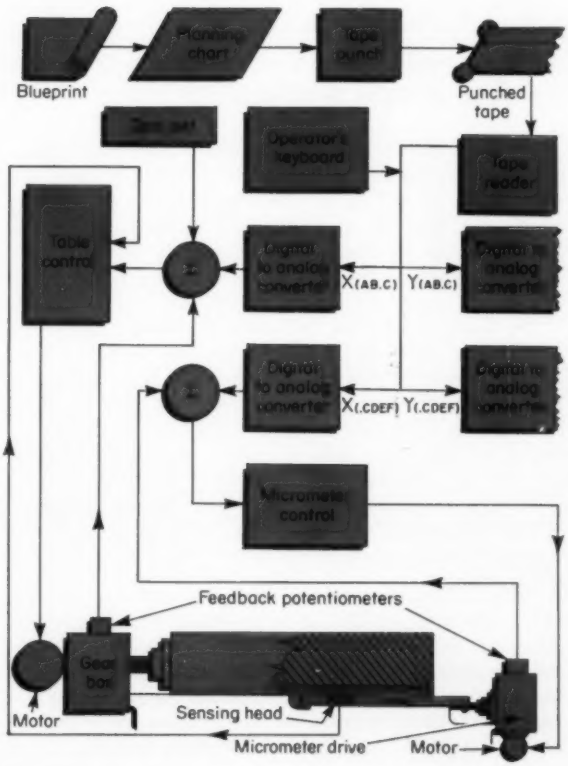
metallurgist, manufacturing engineer, tool engineer, mathematician, data programmer, and machine operator. These functions must be adapted to operate within the limitations of the data processing system. If the data preparation phase for a given type of control is complicated and time consuming or requires an extensive investment in data processing equipment, it is only natural that users and designers alike raise the question of compatibility of systems.

Characteristically, industry has turned to its associations in attempting to solve the problem. In particular RETMA has been studying related equipment associated with the data preparation phase of numerical control. As a result of the studies, it appears that developments have not progressed to the point where standardization is feasible or even desirable in all instances.

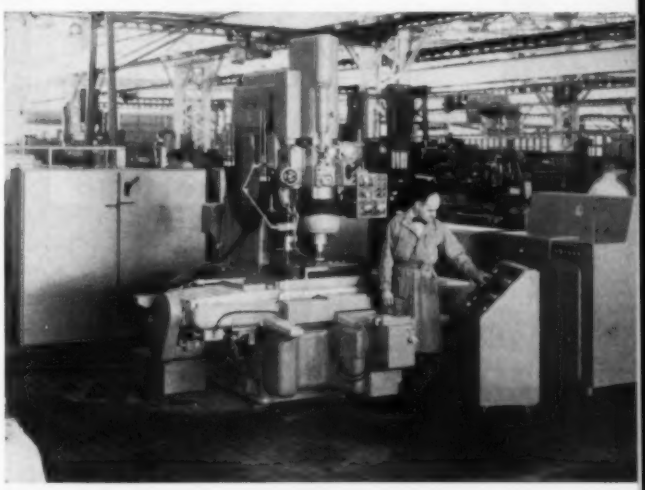
This does not mean, however, that some semblance of order cannot be introduced into the field. The starting point of such an effort is the realization and acknowledgment that the design of numerical control systems is determined by the nature of the function or machine tool system which is to be controlled. This leads to the observation that all numerical control systems are not in competition with each other and, if not distinguished by some classification, standardization can only be achieved by penalizing the simpler requirements.

This, in turn, has led to the classification of systems into one of three general categories: positioning control, straight-cut control, and contouring control. Positioning control for machine tools is characterized by requirements where only the end points of travel are critical. In straight-cut control, there is added to this requirement the necessity to control all points along the path of a cut, but if more than one machine motion is controlled, synchronization of the rates of movement is not required. Contouring control, the most complex form, requires complete and continuous coordination of all machine motions.

It is probable that within the individual classifications some degree of standardization can be achieved. Depending on his requirements, the potential user thus has a correspondingly smaller number of technical points to consider. In general,



Special size punched tape is used to position work table of vertical hole grinder built by Pratt & Whitney Co. Block diagram shows how measuring system is tied into control system.



the problems associated with data processing follow the same pattern previously found in considering the desirability of numerical control: the fundamental issues are clear for both the complex and the simplest form even if agreement on differences has not been obtained.

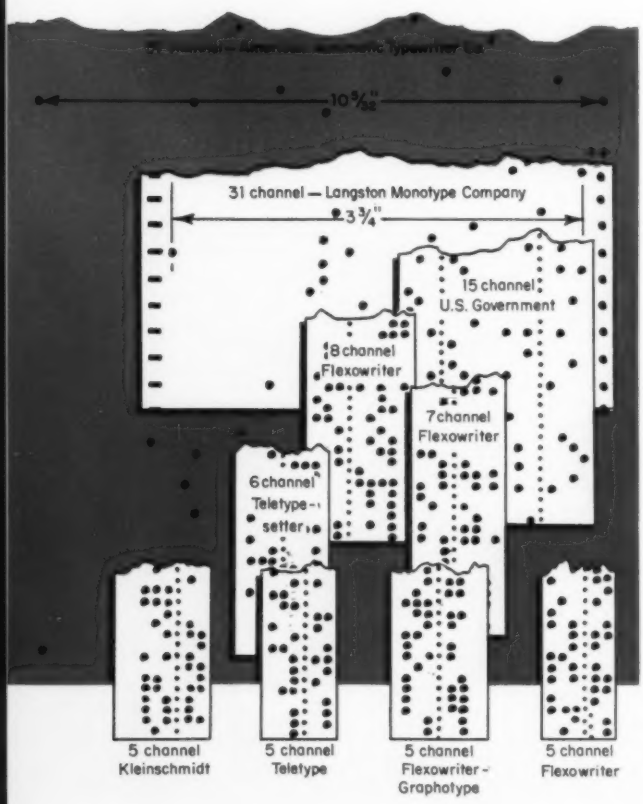
For Smooth Curves

For contouring control, co-ordinated servo-operated drives are used to obtain continuously changing positions of the machine tool slides. Auxiliary functions might also require servodrives but normally are a simple *On-Off* operation. As mentioned, systems have been developed to control as many as five axes of motion and 22 auxiliary functions. This is not necessarily typical of contouring control; it merely indicates how complex a system can be. An example of a simpler form would be a two-dimensional profiler.

Whatever the system, the data processing procedure provides enough main points of a curve on a drawing or plan so that further calculations will result in additional points that completely define the desired curve. The calculations might be made by manual methods or with computers that have been supplied with certain subroutines which enable the points to be specified. Allowances must be made for the fact that a cutter is to be used, auxiliary functions are required, etc. At some stage, the data processing phase must then take the multitude of points and interpolate a smooth curve from them. This furnishes the input signals that, in conjunction with the feedback signals, control the machine tool.

It is in interpolation that variations in systems can be found. In some instances the original computer step also provides for interpolation and the ouput of the computer is used to direct the machine tool. This output is usually in the form of multiple channel magnetic tape. In other instances the computing step prepares an input for separate interpolation equipment which in turn prepares the final medium that directs the machine tool. Here again, the output of interpolation is usually in the form of multiple channel magnetic tape which directs the machine. Still a third system provides each machine tool with an interpolator in which case the input to the machine tool is a punched medium—either cards or tape. Thus, magnetic tape, punched tape, and punched cards are used as media for the input to machine tools for contouring control.

Proponents for each of the various types of systems point to the respective differences as improvements or advantages. However, extensive theoretical discussion of the relative merits would merely be redundant. The systems are ordered and are being delivered, and this year should see the build-up of factual operating data on which to judge the actual merits of each type. Those interested in this subject should follow the efforts of the Aircraft Industries Association, Numerical Control Subcommittee. This group is vitally interested in the problem of compatibility of contouring control systems at the parts level, and in actively following developments in this area.

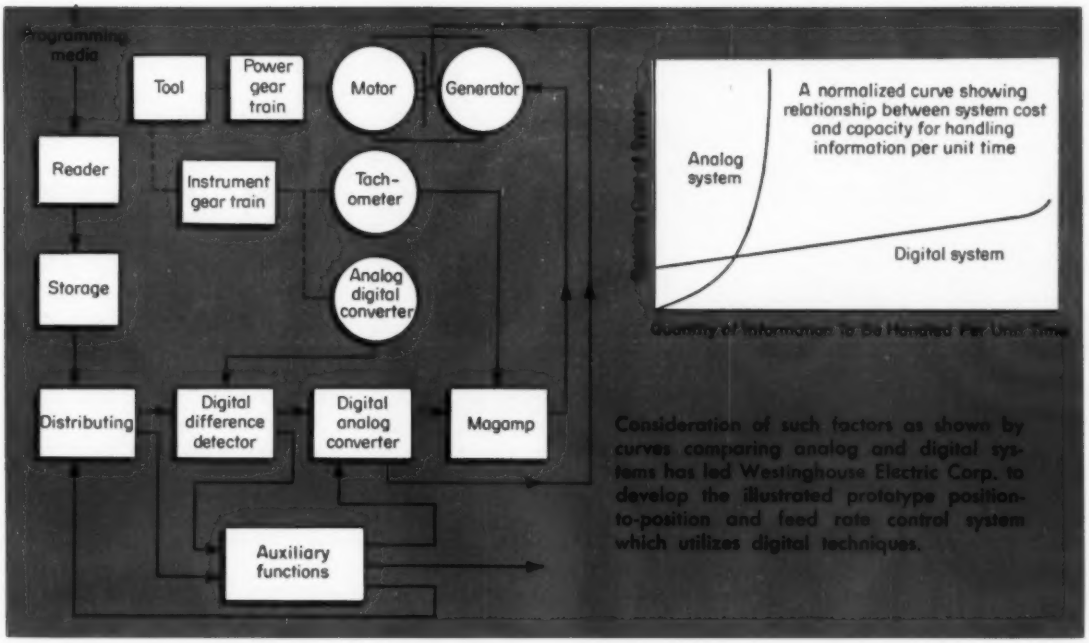


Representative examples of punched tape forms in use in communications and data processing industries. Tapes and related preparation and reading equipment can be applied to machine tool numerical control.

Point to Point Movement

For positioning control, simplicity and cost are prime determinants of the form the data processing equipment will take. Seemingly, these requirements can best be met by adapting existing and proved forms of equipment, especially when the possibility exists that the same equipment can be of general use in the purchaser's plant.

The communications and data processing industries have, over the years, developed highly adequate means of storing, reading and reproducing data automatically. Punched tape, in a variety of forms, is in wide use in the communications fields; the data processing field is closely associated with the use of punched cards and, more recently, with tape in both punched and magnetic forms. Some of the equipment and techniques used in these industries can be applied directly to numerical control systems.


Programming media
Tool
Power gear train
Motor
Generator
Reader
Instrument gear train
Tach-ometer
Storage
Analog digital converter
Distributing
Digital difference detector
Digital analog converter
Magamp
Auxiliary functions
A normalized curve showing relationship between system cost and capacity for handling information per unit time
Analog system
Digital system
Quantity of Information To Be Handled Per Unit Time
Consideration of such factors as shown by curves comparing analog and digital systems has led Westinghouse Electric Corp. to develop the illustrated prototype position-to-position and feed rate control system which utilizes digital techniques.

Simpler forms of numerical control are not designed to eliminate as many operator tasks as complex forms. If the machine operator is to retain an important role, he must understand and be able to handle and manipulate the work aids given him without the need for extensive retraining or complicated equipment. Punched media systems can be designed that are simple enough for the machine operator to handle completely with inexpensive equipment. This has concentrated interest in punched media.

So far as control specialists are concerned, whether to use punched tape or punched cards is a matter of the user's preference. Thus, machine tool manufacturers, in setting up a line of numerical control equipment, have had to investigate the merits of both cards and tape. Evidence shows that both are being used.

In judging the two forms—cards or tape—these are the factors considered: the extent and use of existing business equipment which also can be applied to numerical control; suitability of equipment to production floor operating conditions; the amount of training necessary for use; detailed requirements for punching operations; information coding requirements of system; ability of operator to visually interpret punches on the media; and methods of filing.

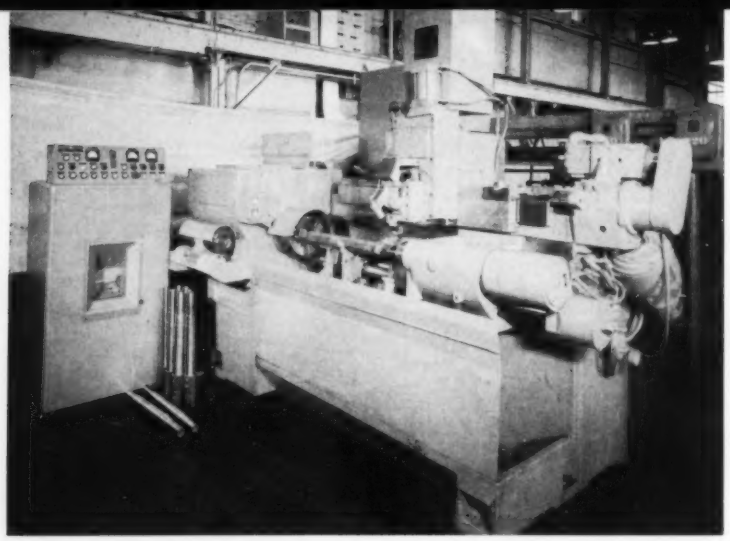
Punched tape has been found to be well suited for storing series of operations which must be followed in a set sequence. Cards are well suited to storing individual operations where insertions or deletions occur frequently. Also, a single card can contain complete instructions related to a single part in simple situations.

In some cases, however, manufacturers have felt that commercially available data handling equipment is unsuited to the peculiar requirements for machine tool control and have developed special forms. These developments, in general have aimed for more rugged equipment and system simplicity.

▶ The Middle Ground

Straight-cut control, so far as data preparation is concerned, is more closely related to positioning control than contouring control. The two forms of control are so closely related that not all manufacturers distinguish between them. Straight-cut control is thought of as improved positioning control. However, if only the end points of travel are critical, the path taken in moving between the points is immaterial, with speed of movement being the main consideration. Overshoot in positioning control can be tolerated. As opposed to this, in straight-cut control the path becomes critical and overshoot cannot be tolerated. The two systems are similar but straight-cut control is more complex, mainly because of the need to eliminate overshoot by controlling the rate of motion. Compared to positioning control, more auxiliary functions are normally involved. This leads to the need for more effective utilization of channels on the storage medium by coding or to the use of a medium with more channels. In straight-cut control use has been made of the commercially available storage media, but system designers have not hesitated to develop special forms in searching for overall system simplicity.

The computing requirements for the simpler forms of numerical control are handled by equip-



Example of straight-cut control applied to Sundstrand single-point lathe. Input to separate General Electric controls is by punched cards.

ment contained with the control system on the machine. Extensive data processing and computer installations are not required since synchronization of rates of movement of several axes is unnecessary. The actual computing requirements for a given system vary according to the methods of coding, input information and form of feedback but most machine tool operations require no more computation than a simple direct comparison of data.

The potential application of the simpler forms of numerical controlled machine tools has raised some interesting considerations. Jones & Lamson Co. has developed and demonstrated a numerically controlled turret lathe. D. N. Smith, manager of research for the company, in discussing their philosophy of applying numerical control for such a turret lathe, uses the term "family of parts." It is a term that might be thought of as applying to a variety of parts with similar machining requirements. If the machine tools to satisfy the requirements are provided with numerical control and grouped together to simplify the parts movement problem, then production line efficiency results for job shop requirements.

An excellent example of this philosophy for

List of some of the companies associated with developments in numerical control for machine tools. The types of input used in the various developments are stated because they suggest the data preparation requirements for the individual systems.

Allison Equipment Co., Santa Monica, Calif. Has developed magnetic tape controlled positioning table which is programmed and operated by record-playback technique. (See AUTOMATION, Mar. 1957)

Arter Grinding Machine Co., Worcester, Mass. Manufactures punched tape controlled positioning table (Jigmatic). Uses direct reading decimal information on 5-channel tape. Including tape preparation and setup time, company reports own experience with table in drilling operations shows average time reduction of 32.3 per cent. (See AUTOMATION, Feb. 1957)

Autonetics, Div. of North American Aviation Inc., Los Angeles, Calif. For self-use has developed two-dimensional profile milling control (Numill). Uses magnetic tape input for control of Cincinnati Hydrotel miller in machining templates, profile bars, fixtures, etc. System applicable to other machines such as lathes and boring mills.

Avey Drilling Machine Co., Cincinnati, Ohio. Expects to enter field with card-programmed control of rotary index table and actuation of auxiliary machining units.

Barnes Drill Co., Rockford, Ill. Offers punched tape controlled drilling machines in which positioning table and drill head are controlled. System applies to vertical or horizontally traveling drill head and rotary index table.

Barnes Engineering Co., Stamford, Conn. Manufactures punched tape control system (Binotrol) for machine tools. Demonstrated in Jones & Lamson turret lathe. Uses special 5-inch wide plastic tape which provides for 32 channels of information. (See AUTOMATION, Nov. 1955)

Bendix Aviation Corp., Detroit, Mich. Developed contouring control system which uses punched tape input to machine tool control. In producing three-dimensional cams, company reports manufacturing time reduced from 200-400 hour range to 18-38 hour range. With addition of magnetic tape reader, machine control unit can use digital magnetic tape. Punched tape from computer stage can be used to operate either analog or digital magnetic tape director. (See AUTOMATION, June 1956)

H. L. Barnebey Chemical Processes, Columbus, Ohio. Holds American licensing rights to CIFA system developed in Italy. System uses punched steel tape and photoelectric scanning head. Primarily a tape template control useful where only longitudinal positioning of relatively long parts is required, such as in drilling of structural steel.

Cincinnati Milling Machine Co., Cincinnati, Ohio. Offers contouring control system in which punched cards serve as input to machine tool control. Can be applied to two or three-axis control. Based upon development work originally done by E.M.I. Engineering Development Ltd., England.

Commercial Controls Corp., Rochester, N. Y. Manufactures 5, 6, 7, and 8 channel paper tape and related equipment for tape preparation and reading (Flexowriter).

Concord Control Inc., Boston, Mass. Designs and builds numerical control systems for machine tools. Under subcontract to Giddings & Lewis to manufacture 12 tape preparation desks and three director systems for Numericord system.

Electronic Control Systems Inc., Los Angeles, Calif. Has developed contouring control system for sale to machine tool manufacturers. Control unit (Digimatic) consists of two principal units: planning desk, which includes computer and machine control unit. Input to control unit is on magnetic tape. (See AUTOMATION, July 1956)

Electric Controller & Mfg Co., Cleveland, Ohio. Manufactures punched card programming unit which has been applied to control of roll openings for steel mill rolling operations. (See AUTOMATION, Mar. 1957)

Farrand Controls Inc., New York, N. Y. Has developed control system (Inductosyn) which can be applied to variety of machine tools. System can be adapted to desired input media.

Ferranti Ltd., Edinburgh, Scotland. Developed various control systems which utilize magnetic tape as input to control unit. Noted for use of optical grating as linear digital transducer in feedback unit. (See AUTOMATION, Dec. 1955)

General Electric Co., Waynesboro, Va. Actively associated with many developments in numerical control including Giddings & Lewis Numericord system, Sundstrand lathe, and Wiedemann punch press. Thus, activity covers contouring, straight-cut and positioning control systems; and magnetic tape, punched tape, and card systems.

the use of numerical controlled equipment is located at the Mission Mfg. Co., Houston, Tex. (See AUTOMATION, April 1957). The parts to be produced are piston rods for mud pumps; approximately 600 models, ranging from 1-inch diameter by 2 ft long, to 4-inch diameter by more than 5 ft long are involved. Production requirements total several thousand a month and the average order is for 20 to 30 pieces, but the company must be prepared to supply only one or two pieces if needed. The company is working toward an installation consisting of a number of numerically controlled machines to produce these parts in the flexible manner required. Operations included in production which are to be numerically controlled are sawing, tapping and centering, stamping, end turning, semifinish turning, and knurl milling. Because of the close similarity of the parts the idea is clearly represented by this example, but for other cases the possibility exists that it will be worthwhile to redesign parts or review processes to create a "family of parts" which can be produced by a numerically controlled group of general purpose machines.

▶ A Bright Future

R. H. Schuman, chief physicist, Warner & Swasey Co., in a recent paper[2] summed up the real gains obtained with numerical control for machine tools as depending upon these two points: With no tolerance in commands given to the machine, the first piece made can be an acceptable piece; and since essentially zero time is required at the machine to insert control commands, the machine can be made to produce parts during a greater percentage of the time that the machine stands on the production floor. It is the first factor which has a high dollar value in the case of complex operations. The second factor leads to a whole interrelated series of possibilities effecting the economy of operations in a given shop.

Thus, numerical control is approaching the point where the user will become the dominant factor in determining the future of the concept. This is also true in the area where problems now appear to exist. For instance, such problems as standardization will in the long run be solved naturally by what the majority of users prefer.

It is not simply because of the potential in machine tool control that numerical control is important to industry. Numerical control techniques in various forms have been applied to numerous situations where sequencing, positioning, and calculating are performed. Typical examples include batch control involving the blending of materials; ultrasonic testing requiring sequencing of test points; electronic circuit testing requiring sequencing and switching operations; welding operations involving positioning, etc. Also, the basic equipment and techniques used in numerical control are closely allied to data processing which is widely used in industry. All of these factors suggest that the real potential of numerical control has yet to be fully realized.

REFERENCES

1. C. B. Perry and B. Galennie—"Numerical Control of Machine Tools," a report from the AIA-AMEC Numerical Control Sub-Committee.
2. R. H. Schuman—"A General View of Numerical Control," Eighth Annual AIEE Conference on Machine Tools, Oct. 1956.

General Riveters Inc., Buffalo, N. Y. Uses punched 35 mm movie film to control positioning of aircraft panel sections requiring drilling and riveting. Three tapes are used in obtaining transverse and longitudinal movement of worktable and in controlling riveting sequences. (See AUTOMATION, Sept. 1955)

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Developed contouring control system (Numericord) which uses magnetic tape as input to machine tool control. System can be used as record playback control if desired. (See AUTOMATION, Sept. 1955)

Gisholt Machine Co., Madison, Wis. Has described turret lathe equipped with numerical control system (Factrol) that meets the definition of contouring control. Magnetic tape, prepared on unique analog computer-recorder, serves as input to the control system.

Hillyer Instrument Co. Inc., New York, N. Y. Manufactures spot-drilling machines for light work in which input to controls is by punched tape or numerical dials.

International Business Machines Corp., Endicott, N. Y. Utilizes vertical spindle miller equipped for contouring control to prepare two-dimensional master cams. Binary coded data on eight-channel punched tape serves as input to the machine in controlling a rotary table on a linear slide. Company's digital computers are used in complex numerical control data preparation operations. (See AUTOMATION, Mar. 1956)

Jones & Lamson Machine Co., Springfield, Vt. Has demonstrated turret lathe equipped with Barnes Engineering Co. numerical control system (Binotrol). Similar punched tape control used for drill press equipped with numerical controlled positioning table. Positioning table controls equipped with dials for manual input if tape preparation not warranted. (See AUTOMATION, Nov. 1955)

The Maico Co. Inc., Minneapolis, Minn. Developed the magnetic tape control system (Factrol) used by Gisholt on turret lathe.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. For self-use, has applied punched tape controls to 4-spindle Excello boring machine used in boring short holes in gear plates. Company has also developed special manual dial controls for drilling machine used in preparing control panels for mounting of instruments. (See AUTOMATION, Sept. 1955)

Monarch Machine Tool Co., Sidney, Ohio. Has demonstrated lathe equipped for numerical sequence programming control. Master panel board contains multiplicity of selectors which are positioned to obtain desired cycle, spindle speeds and feed rates.

National Automatic Tool Co. Inc., Richmond, Ind. Expects to enter field with punched tape positioning control system suitable for multispindle drilling, tapping and boring machines.

Pratt & Whitney Co., W. Hartford, Conn. Has developed punched tape positioning control system applicable to its line of jig borers, vertical hole grinders and rotary tables. Special tape and electropneumatic sensing system are used. Feedback system built around Electrolimit measuring system used on company's manually-operated jig borers. (See AUTOMATION, Dec. 1956)

Sperry Products Inc. Developed punched tape control (SIMAC) for ultrasonic testing equipment. System utilizes 60-channel tape for positioning of scanning head. (See AUTOMATION, Oct. 1954)

Sundstrand Machine Tool Co., Rockford, Ill. Has equipped multicycle single point production lathe with General Electric punch card control. As much as 80 per cent reduction in setup time reported for unit in use. (See AUTOMATION, Sept. 1955)

Warner & Swasey Research Corp., New York, N. Y. Manufactures tape or card programmed controls (Probomat) which have been applied to positioning control of machine tools and to automatic measuring machines.

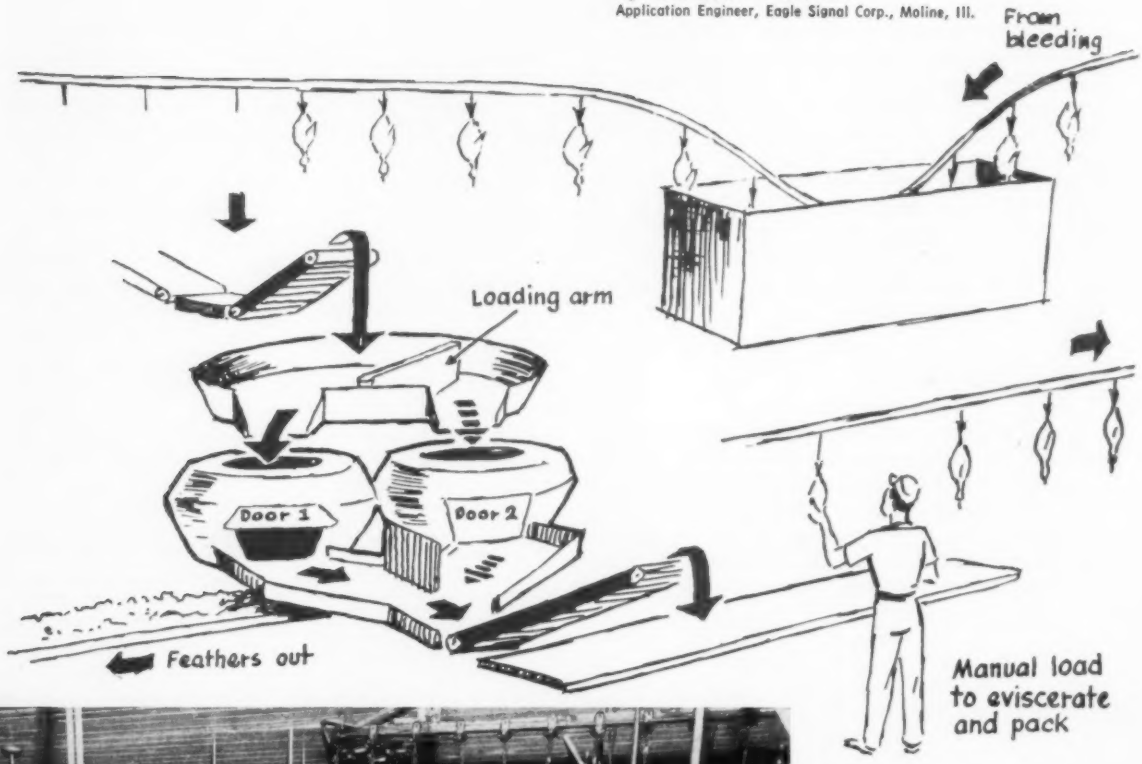
Westinghouse Electric Corp., Buffalo, N. Y. Has described positioning and feed rate control system which utilizes input by punched cards. Information is coded on IBM cards in binary form.

Wiedemann Machine Co., Philadelphia, Pa. Demonstrated punched tape controlled turret punch press using General Electric Co. control. General Electric has also described punched card control of same type of press. (See AUTOMATION, Sept. 1955)

AUTOMATION TODAY

AUTOMATED CHICKEN PICKING

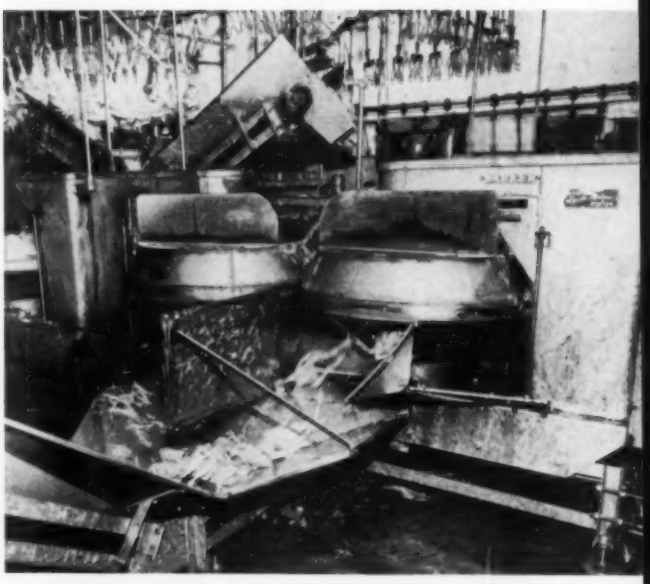
By WILLIAM A. WOEHR
Application Engineer, Eagle Signal Corp., Moline, Ill.



1

In this automated installation chickens are hung by their feet from special hangers on an overhead trolley conveyor. They are bled and moved into and out of a scalder (right) to loosen their feathers. Scalded chickens are unloaded from the hangers onto a platform (center) that supplies slat conveyors which deliver chickens to each of two loading platforms servicing two Cyclo-Mation machines made by Barker Poultry Equipment Co. Each of these machines has two chambers which are alternately loaded by an arm that can be seen sweeping 24 chickens from the platform.

2



Picking of feathers is accomplished by pliable rubber fingers continuously spinning within the picking chambers. Loading and picking cycles are controlled by timers. Each chamber is unloaded by the opening of its door. Chickens whirl out onto pickup platform of a slat conveyor.

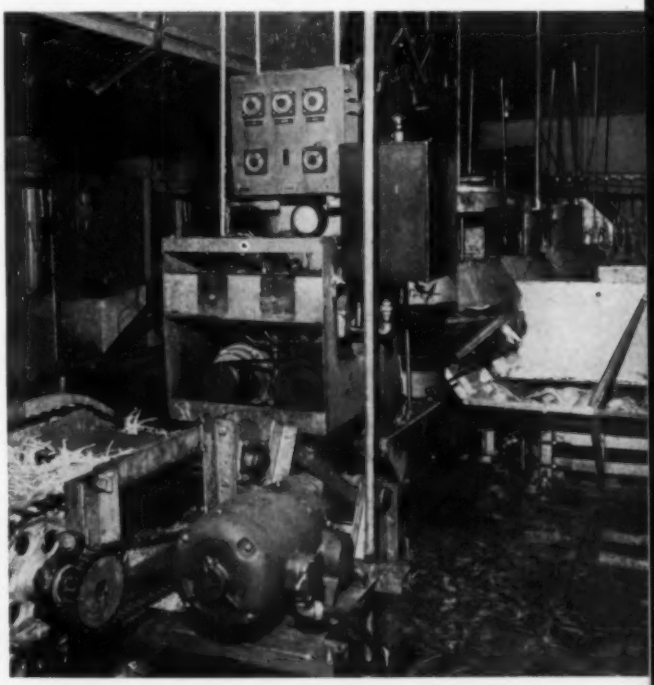
PICKING FEATHERS from poultry to prepare it for market is an operation that formerly required considerable manual labor. Automated equipment has been developed to perform this operation. Poultry ranging from 1½-pound Cornish hens to 30-pound turkeys can be processed in a machine developed by the Barker Poultry Equipment Co. Automated chicken picking with this machine, called the "Cyclo-Mation," can be set up on a production basis to handle 2500 three-pound chickens per hour.

First step in the process is to hang the chickens by their feet from hangers on an overhead trolley conveyor. Birds are bled and moved into a scalder. This loosens the feathers and prepares the poultry for the picking operation. Each picking machine has two chambers which are loaded alternately from a common platform. These cone-shaped picking chambers enclose large, piable rubber fingers whirling continuously on a central shaft. These fingers pick both with and against the lay of the feathers to assure a thorough picking job. The arrangement used is able to clean off even the hard-to-remove feathers from around the neck and tail of the birds.

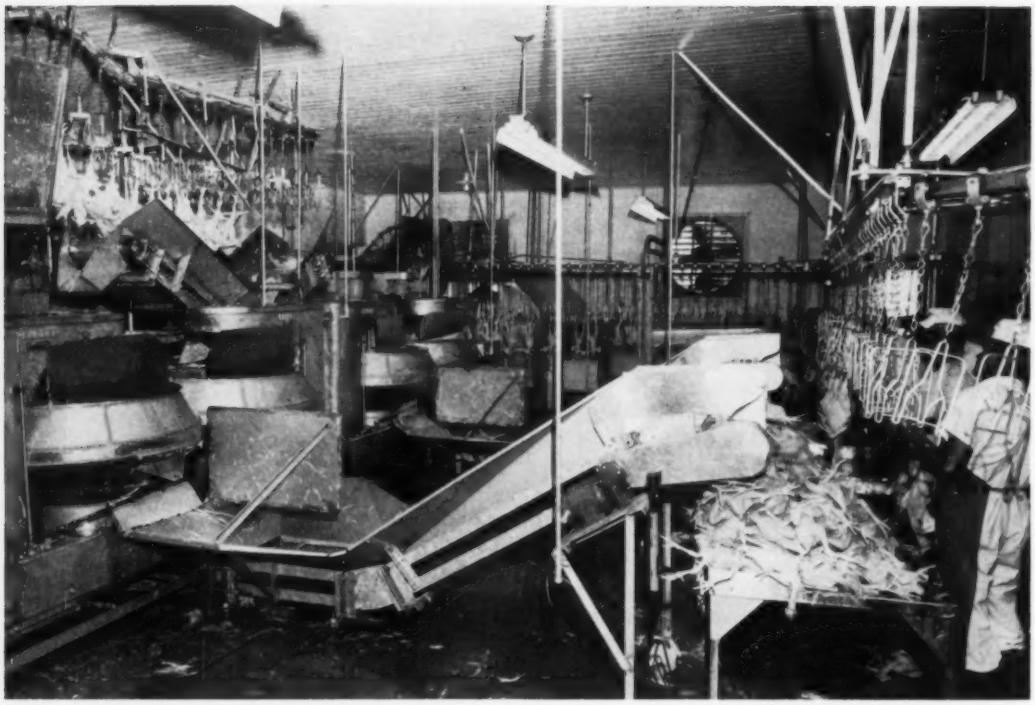
To sequence the operation of these machines and cause the loading and unloading of each chamber alternately so that one chamber is picking while the other is being unloaded and loaded again, a special arrangement of Eagle Signal Corp. timers was engineered to actuate the various elements of the machine. Since size of bird, quantity in each batch, and time in the picking phase of the operation each has an effect on the establishing of the optimum cycle, this method of control has particular advantages for the operation of these picking machines. In addition to the time basis of control this hookup provides for programing of the events in the required sequence.

At the end of the picking phase of the cycle the timer actuates the door opening mechanism and allows the chickens to be discharged from the chamber. A conveyor delivers them to a table where they are manually loaded onto a conveyor that takes them to the eviscerating and packaging rooms. There they are made ready for market.

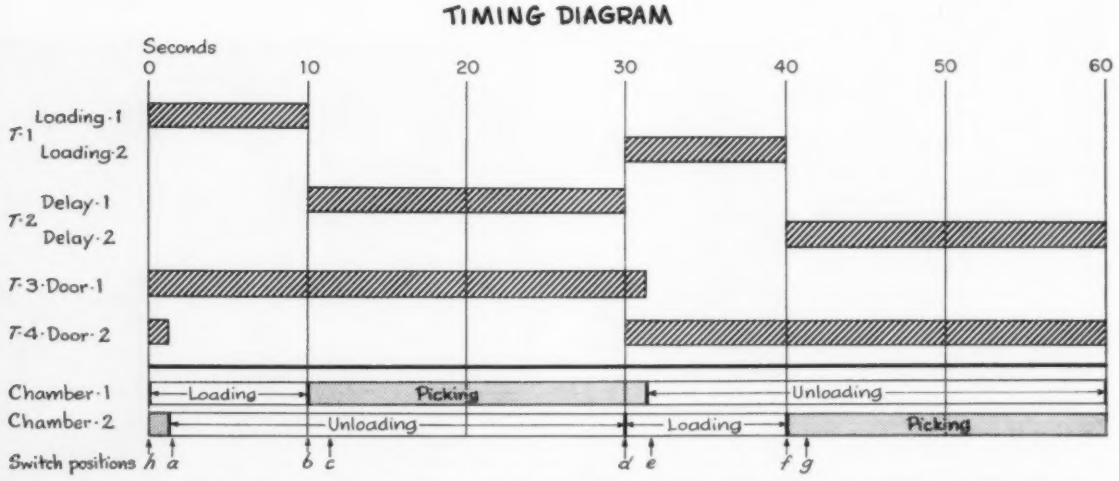
3



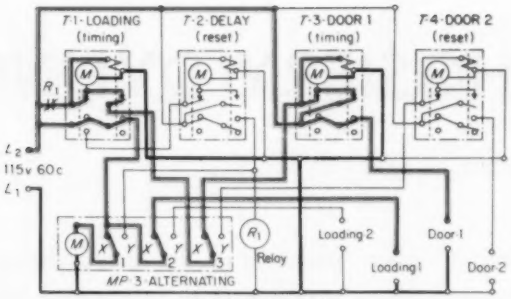
End view of machine shows drive end of conveyor that brings feathers out from underneath picking chambers. Control panel above main machine drive equipment encloses five Eagle Signal Corp. timers in a package specifically engineered for this application. Timers actuate solenoid valves which operate hydraulic cylinders that cause loading and unloading to take place.



4 Processed chickens are delivered to tables where they are placed on hangers on a trolley conveyor that removes them to the eviscerating and packaging room. Visible in this picture are the conveyors that bring the feathered chickens to the automated machinery and take the featherless birds away.

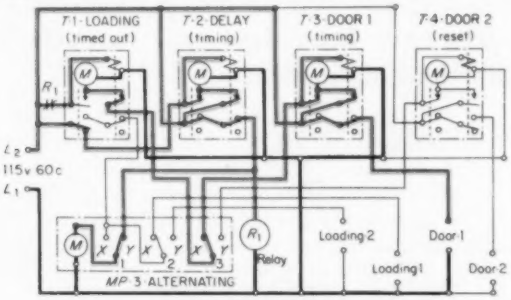


5 Loading of picking chambers is actuated by *T*-1 Loading timer wired internally to permit timing only when relay *R*-1 is closed (de-energized). Relay *R*-1 contacts are held open when *T*-2 delay timer is timing. Timing period for *T*-2 is started by timing out of *T*-1. *T*-2, 3, & 4 are internally wired so as to run after only momentary contact of the switch that initiates timing. Door closing actions occur simultaneously with loading actions and the door timers are started alternately with the starting of *T*-1. Alternating action is accomplished by *MP*-3 Multipulse timer which rearranges switch positions during the cycle illustrated by the timing diagram and switch positions *(a)* through *(h)*.



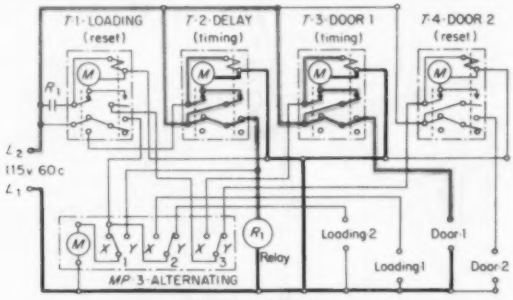
Switch Position *(a)*

Applying line power starts *T*-1, energizing Loading 1 to load batch of birds into Chamber 1. This also starts *T*-3 which holds Door 1 closed. First batch is now being picked. *MP*-3 starts in position shown but runs only until Switch 1 moves to y position.



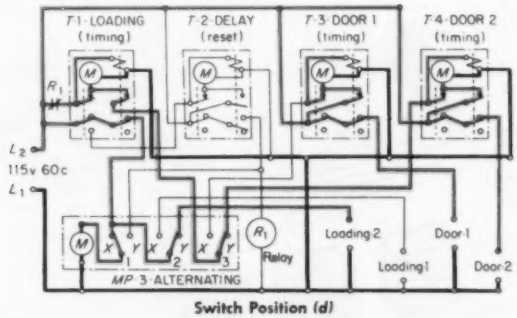
Switch Position *(b)*

***T*-1 times out causing the loader to retract and starting *T*-2. In its timing position *T*-2 starts the motor on *MP*-3. *T*-2 energizes Relay 1 which opens *R*-1 contacts, thereby causing *T*-1 to reset after only momentarily being in timed out position. *T*-2 in timing position maintains *R*-1 contacts open, thus delaying the restarting of *T*-1.**



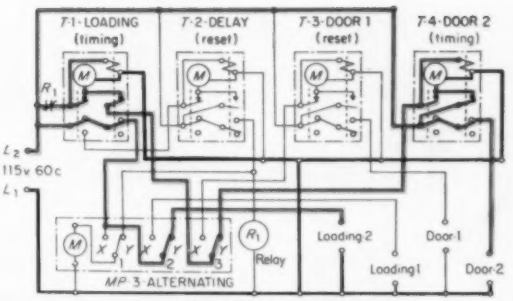
Switch Position *(c)*

***T*-2 and *T*-3 continue to time, picking chickens in Chamber 1. *MP*-3 moves switches 2 and 3 to y positions, then moves Switch 1 back to *x* position thus stopping *MP*-3 motor.**



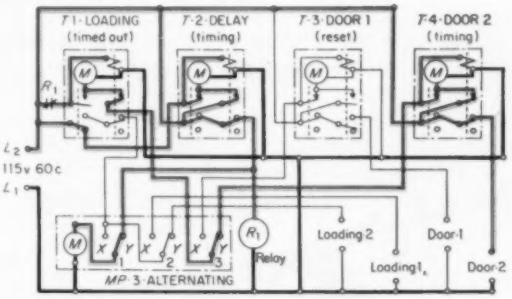
Switch Position *(d)*

***T*-2 times out and immediately resets, allowing *R*-1 contacts to close, thus starting *T*-1 energizing Loading 2 to load batch of birds into Chamber 2. This also starts *T*-4 which holds Door 2 closed. *T*-3 is still timing. *MP*-3 starts in position shown but runs only until Switch 1 moves to y position.**



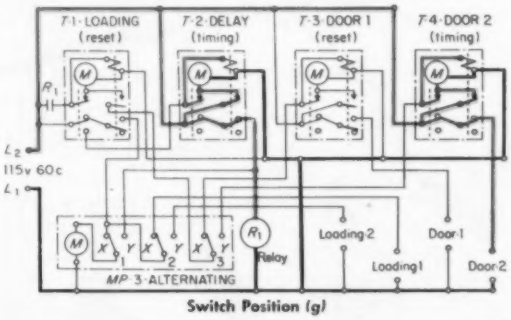
Switch Position *(e)*

***T*-3 times out and immediately resets, allowing Door 1 to open and picked chickens to be discharged from Chamber 1.**



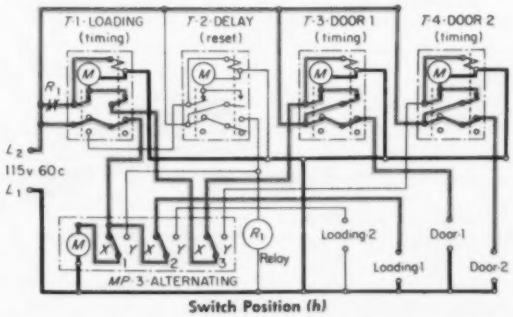
Switch Position *(f)*

***T*-1 times out causing the loader to retract and starting *T*-2. This condition is identical to Switch Position *(b)* except that *T*-4 is now timing instead of *T*-3. *T*-2 again starts motor on *MP*-3, and by action on *R*-1 resets *T*-1 and delays its restarting.**



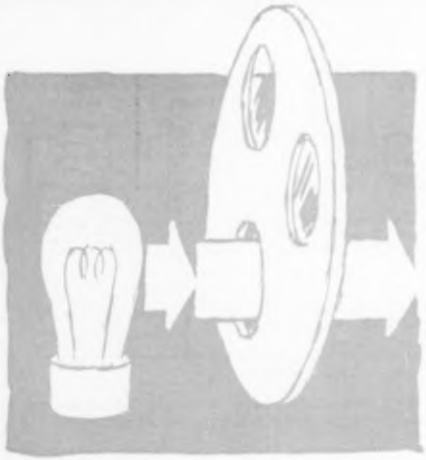
Switch Position *(g)*

***T*-2 and *T*-4 continue to time, picking chickens in Chamber 2. *MP*-3 causes Switches 2 and 3 to return to *x* position and then moves Switch 1 back to *x* position thus stopping *MP*-3 motor. *MP*-3 has completed its cycle.**



Switch Position *(h)*

***T*-2 times out and immediately resets allowing *R*-1 contacts to close thus starting *T*-1 to repeat the original cycle. In two seconds *T*-4 will time out, immediately reset, and allow Door 2 to open and picked chickens to be discharged from Chamber 2. All cycles continue to repeat as described.**



HOSIERY DYEING

Conversion from processing in intermittent steps to continuous processing in integrated operations frequently offers sizable savings. To effect such savings in hosiery dyeing the processes, handling, and control means described in this article have been developed to perform many functions automatically.

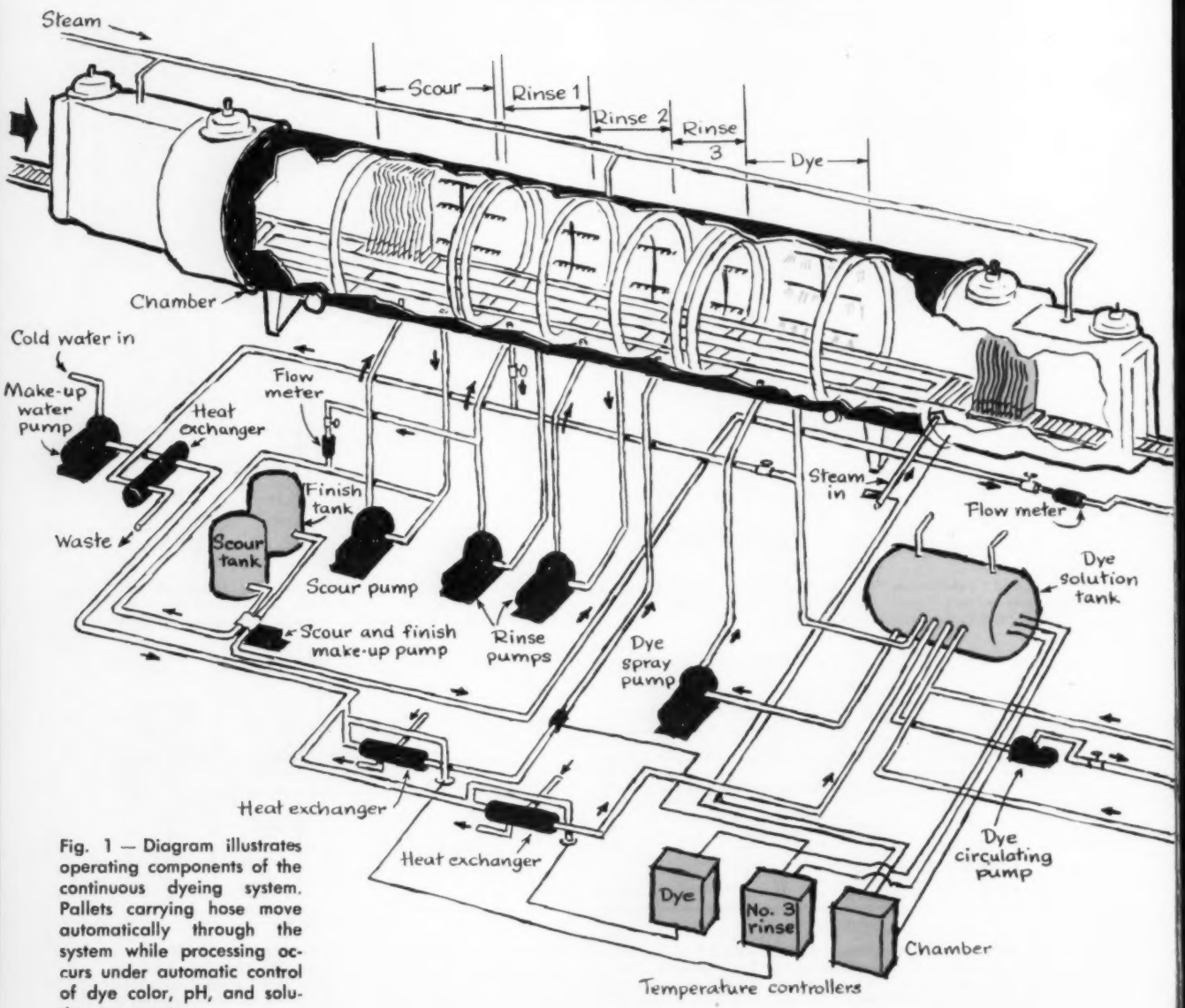


Fig. 1 — Diagram illustrates operating components of the continuous dyeing system. Pallets carrying hose move automatically through the system while processing occurs under automatic control of dye color, pH, and solution temperatures.

GOES CONTINUOUS

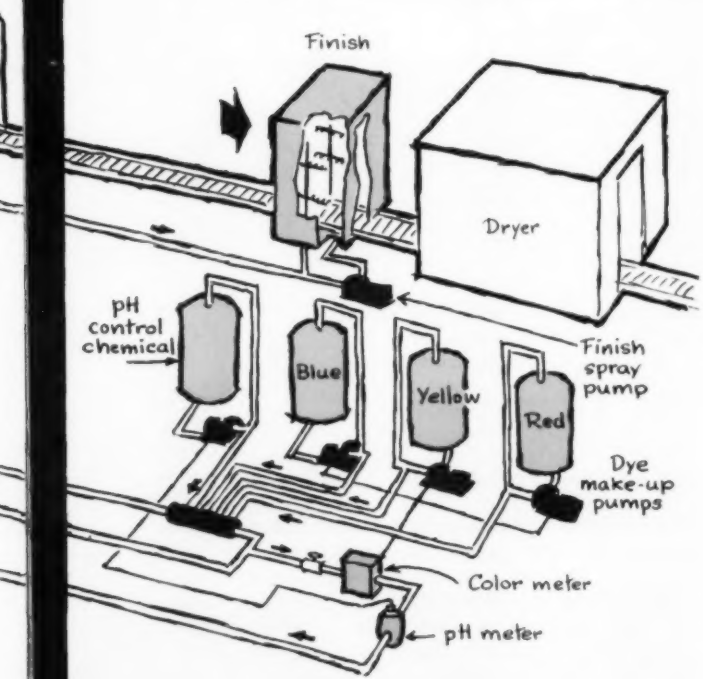
WITH AUTOMATIC COLOR CONTROL

ADVANTAGES of continuous processing techniques over slower batching methods are apparent in many fields. One area in which their application will be readily appreciated by all the women of the country—and the men—is in the production of nylon hosiery.

After hose have been knit, they must be set to the desired shape, chemically scoured to prepare for dyeing, dyed to a desired shade, and chemically finished, with suitable intermediate rinsing.

In the past, setting the desired shape has been accomplished by putting the hose individually on forms before and after chemical processing; with the processing, such as scouring, dyeing, finishing and the necessary intermediate rinsing, being done by packing the hose into bags and moving the bags into and out of processing chambers. In a typical sequence of operations the hose were: preboarded or preset, folded for dyeing, bagged, scoured, rinsed, dyed, color checked, rinsed again, chemically finished, put through extracting, removed from the bag, sorted for size, final boarded and stripped. Each of these 14 steps was a separate batch operation with the usual delays and interruptions in the movement of goods through process steps.

To eliminate the "stop, wait and go" of this interrupted batching procedure, Proctor & Swartz Inc. has developed a system which they call Electrocolorset. This system makes it possible to board hose on forms and eight minutes later strip them off, completely processed and ready for pairing and boxing. In effect, 14 operations are reduced to three and 150 dozen pairs can be processed per hour.



Processing System

Scouring, dyeing and rinsing in the continuous system take place in a large mutisection pressure chamber where process solutions can be sprayed on the hose. Chemical finishing is accomplished by spraying in another chamber, and the hosiery is then dried.

Equipment for the continuous process is illustrated by *Figs.* 1 and 2. Hose are boarded on forms attached to movable pallets, each pallet having 24 forms. Loaded pallets move by conveyor to the entrance of the multisection chamber. Two pallets enter a vestibule, a door closes, the vestibule is brought to a desired pressure by admission of steam, an inner door opens, and the pallets are moved into the processing chamber. Detailed breakdown of the vestibule cycle shows: 2.0 seconds for outer door to open, 8.5 seconds for pallets to enter vestibule, 2.0 seconds for outer door to close, 8.5 seconds for steam to enter, 2.0 seconds for inner door to open, 8.5 seconds for pallets to enter process chamber, 2.0 seconds for inner door to close, and 14.5 seconds to bleed steam from the vestibule.

Each vestibule door is suspended from a vertical trunnion connected to a crank arm above the chamber. A connecting rod links the trunnion crank to a crank arm half as long, which is mounted on a vertical countershaft. By turning the countershaft 180 degrees the door assembly is rotated 90 degrees. An electric motor that runs continuously turns the countershaft intermittently as the electric clutch which links them is alternately energized and de-energized.

After two pallets enter the processing chamber, one of them is pushed sidewise to another track so that the pallets travel through the chamber on

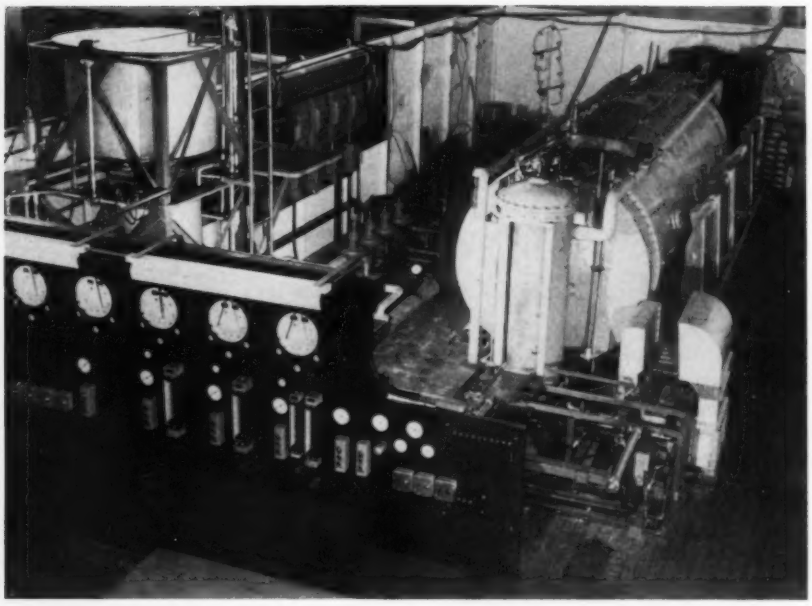


Fig. 2—Pilot installation of system to dye hosiery on a continuous process basis. Handling of bags of hosiery in and out of process steps is eliminated and flow time reduced.

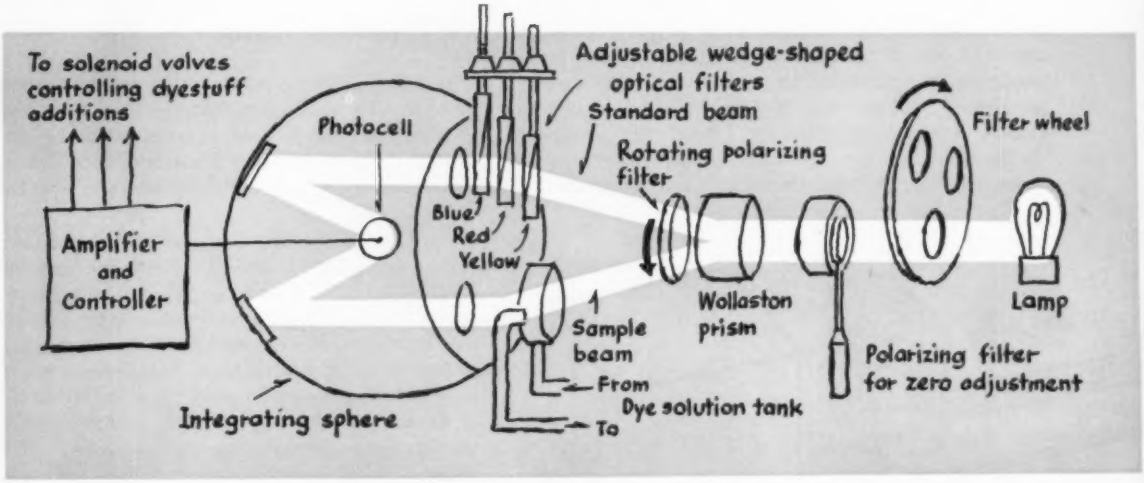


Fig. 3—Sketch shows operation of the color comparison system. By passing the dye solution through a sample cell, it can be compared to a standard established by operator settings. Deviations result in signals to valves controlling additions of dyestuffs.

two parallel tracks. Continuously moving chains with pusher dogs convey the pallets through the processing sections. At the exit end of the chamber the pallets are returned to a single track and pass out two at a time through an exit vestibule similar to the one through which they entered.

The pallets carrying the dyed hosiery then are moved by conveyor through a finishing chamber where chemical finish is applied by spraying and through a finish dryer. Hose are then stripped off the forms on the pallets and taken to packing operations. The pallets are reloaded for a new cycle.

▶ Color and pH Control

Color of the dye is automatically controlled in accordance with preset selections made by the operator. Dye is continuously made up by additions of water and dyestuffs to a dye solution tank. The dye solution in the tank is continuously agitated and pumped through color and pH metering units. In the color control unit, *Fig.* 3, the light transmission of the dye solution passing through a sample cell is compared to a standard at three selected points in the spectrum. Any deviation from desired settings of the color of the

dye results in an electric signal which is used to control additions of dyestuffs.

Since this system makes comparisons at only three selected points of the spectrum, it is not the same as a spectrophotometer which measures the transmission of a sample at all wavelengths. As applied to this control of dye concentration, the selected transmission points are in the red, green, and blue portions of the spectrum to control additions of red, yellow and blue dyestuffs. Because the dyestuffs in the dye solution tank are continuously being depleted by deposition on the hosiery, this color control can correct solely by the adjustment of dyestuff additions without changing the rate of diluent addition.

Flashes of light to check the dye coloring are produced by a filter wheel rotated at 5 rpm in front of a single tungsten light source. The filter wheel carries three filters, blue, green and amber, each of which thus produces an essentially monochromatic flash or beam of light every 12 seconds. Each beam of light passes through a polarizing filter which can be rotated an amount sufficient to zero balance the system when the sample cell contains a clear solvent sample. Next the beam passes through a Wollaston prism which not only splits it into two divergent beams but also polarizes the two beams at 90 degrees to each other. These two beams pass through a polarizing filter which is rotating at high speed. The intensities of the two beams leaving this filter thus vary as sine waves when plotted against time. These intensity curves are displaced 180 degrees so that one beam is at its maximum intensity when the other is at its minimum intensity.

One of these beams, the sample beam, passes through the sample cell, where its intensity is lowered in proportion to the absorption by the dye solution of the light wavelength being transmitted. The other beam, the standard beam, passes through three wedge shaped color filters, blue, red, and yellow. Each of these filters can be positioned by a separate vernier screw mechanism so that the density of filter for each color interposed in the path of the standard beam can be adjusted and duplicated. The intensity of the standard beam is thus reduced by a controllable amount determined by the vernier settings.

By converging the two beams on a single photocell their intensities can be compared; when the beams are of equal maximum intensity, the light falling on the photocell will have a steady intensity. When dye concentration falls below the desired level, the intensity of the sample beam will exceed that of the standard beam and the light falling on the photocell will have a varying intensity, *Fig.* 4.

Separate solenoid valves control the flows from each of the dyestuff supply tanks. In accordance with an amplified signal from the photocell, the proper valve is actuated to increase the desired amount of one of the colors. Which valve is actuated is determined by the position of the blue-green-amber filter wheel at the time the signal is generated.

Either on-off or proportional control may be used to actuate the valves. On-off control provides that a valve is either open a preset amount or closed. To avoid overshooting the desired dye concentration the valve opening for on-off control is kept small. This type control is very satisfactory in maintaining a constant dye color under stable operation, but proportional control permits closer control in cases of rapidly fluctuating demand and permits more rapid change from one color to another with little overshoot. With proportional control the valves open an amount proportional to the color deviation, so that when the deviation is large the valve opening is large to more quickly eliminate the deviation. When the deviation is small, the valve opening is small.

Since acetate dyes are used in this continuous dyeing system, the acidity of the solution must also be automatically controlled. A neutral pH of 7 is maintained by continuously circulating dye from the dye solution tank through a pH meter. When the solution deviates from the desired setting, a solenoid valve is actuated to allow additions to restore the desired pH value.

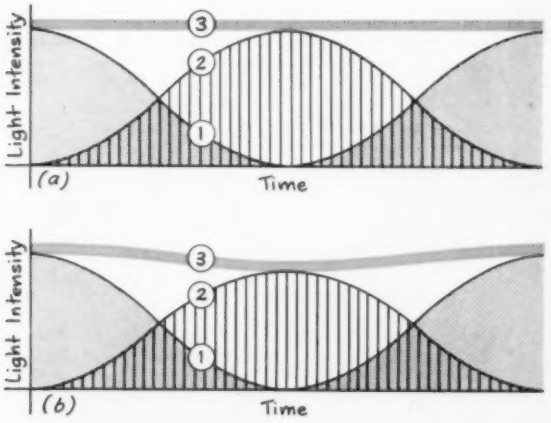


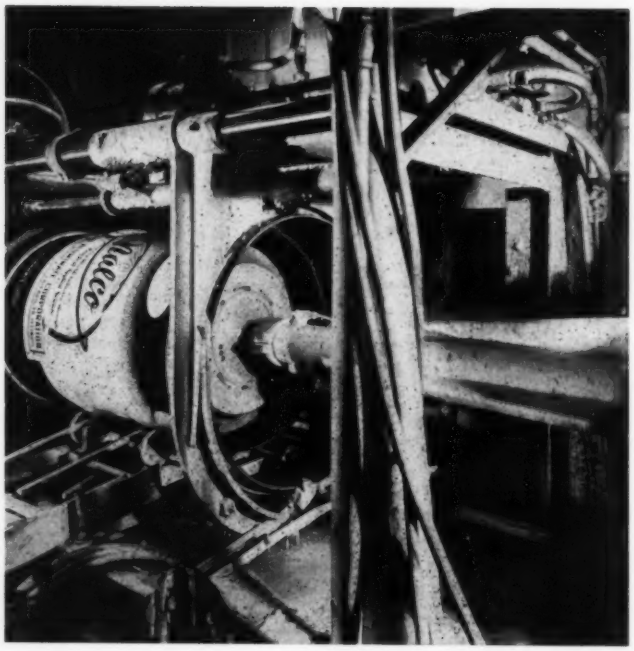
Fig. 4 — Graphs indicating light intensities plotted against time for three points in the color comparison system: (1) sample beam after passing through the sample cell, (2) standard beam after passing through the adjustable color filters, and (3) total light reaching the photocell. *(a)* indicates intensities when dye concentration is equal to the preset value. *(b)* illustrates intensities when dye concentration falls below the preset value.

▶ Benefits of Hosiery System

Use of this continuous processing equipment enables hosiery manufacturers to obtain greater yields of first quality hosiery at lower cost. Tangible savings of from 20 to 45 cents per dozen pairs can be realized in labor and materials, plus savings from improved production control, reductions in pairing labor, improved materials handling, reduced inventory level, savings on mending and regrading, and more efficient use of floor space.

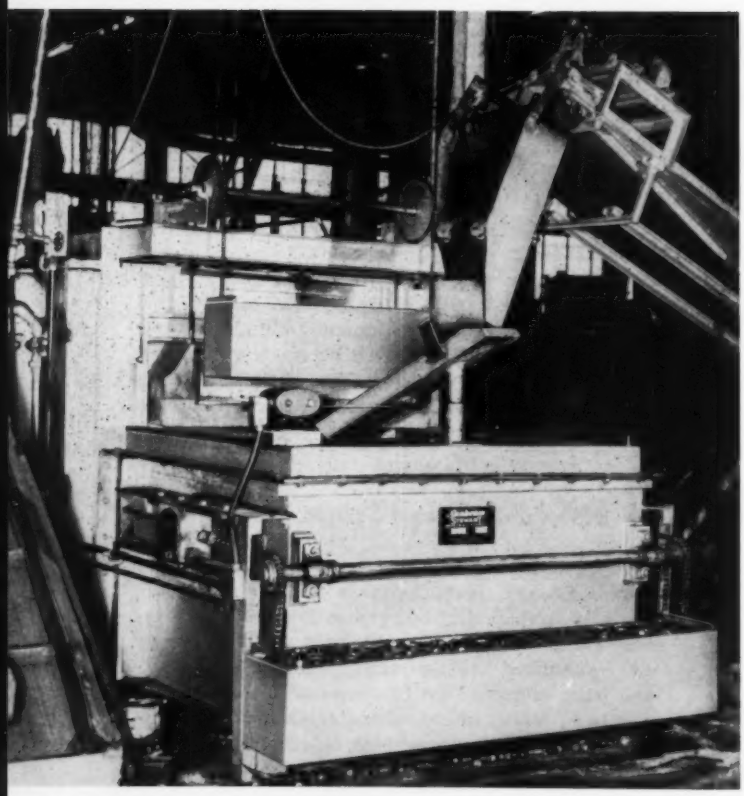
Spectrographic Recorder

AURORA BOREALIS or northern lights will be subject of special study during International Geophysical Year. Perkin-Elmer Corp. has developed an automatic instrument to record the spectrum of the aurora on 16 mm. spectrographic film. Twenty-three such instruments will be placed to obtain a pole-to-pole profile along a chosen meridian. Operating only during night hours, the equipment takes exposures in relation to intensity of the aurora; on bright nights when conditions are not proper for recording, instrument automatically goes into a standby condition. Investigation will be of value to communication industries and defense efforts as the aurora has a pronounced effect on the operation of radio and radar.



Interior Lining

STEEL DRUMS destined to hold certain products must be lined or coated with various materials to insure that the product is not contaminated by reaction with the steel drum. Application of linings by centrifugal force is recent development of Rheem Mfg. Co. Replacing a system in which the body was rotated around a pressure spray, the newer automatic mechanism insures a highly uniform film thickness throughout the interior of the container. The head rotates as it travels longitudinally along the container axis in centrifugally distributing the lining.



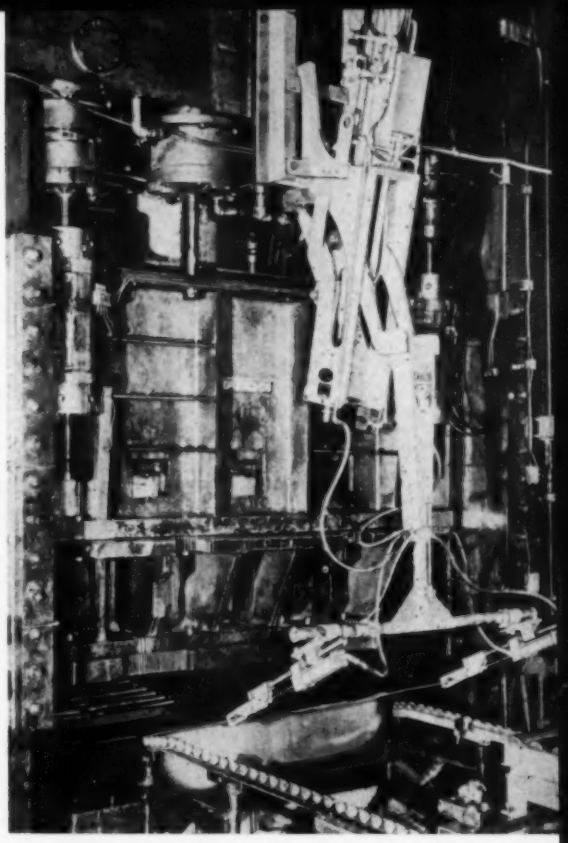
Heat Treating

SPHEROIDIZING FURNACE built by Sunbeam Corp. for Budd Co. is equipped with several handling features which enable 1000 pounds of slugs to be heat treated each hour of furnace operation. Steel slugs are destined for cold extrusion into inter cap nuts used on Budd wheels. At the charge end of the furnace, slugs are carried by inclined conveyor to automatic spreader which swings back and forth across the furnace conveyor. Slugs are evenly distributed on the metal conveyor to insure proper heating in the furnace.

in action

Press Unloading

USE of automatic equipment to unload press at a plant of Kaiser Metal Products Inc. permits utilization of press at top rated speed in production of bathtubs. Production rates of four to five tubs per minute can be obtained on the 1800-ton press on which draws of 15 inches in depth are made in blanks more than 6 feet long. The unloading mechanism is a special model of the Iron Hand produced by Sahlin Engineering Co. and consists of a double-mounted jaw assembly to handle the 120-lb bathtub.



Photocell Control

INDUSTRIAL TRUCK equipped with photoelectric controls can be made to follow white guide line on floor. Operation of Barrett-Cravens Co. tractor is similar to earlier type which follows wire path. Guide line for optical system can be of any good grade of white paint. Light emanating from a small, low-powered bulb on the truck reflects from the guide line and through photoelectric cell circuits steers the tractor along the line at all times.

Case Loader

CARTONS are automatically fed, formed, positioned and loaded in Packomatic machine of J. L. Ferguson Co. Operator of equipment is only required to keep magazine supplied with cartons. Machine can handle round, square or rectangular containers made from paper or metal stock. At the illustrated Simoniz plant, 12 "F" style quart cans of wax are shown being loaded into end-loading cases. Equipment is especially designed to utilize end-loading type cases, a less expensive form of carton because of the smaller closing flaps.

MAGNETS TIME WRAPPER CUTTING

A UNIQUE timing arrangement has been applied in making mineral wool insulation blankets where the mineral wool must be covered with a wrapping. Mineral Wool Insulation Co. of Fontana, Calif. has installed equipment to wrap separate blankets in a continuous wrapping and then cut the wrapping between the blankets. When the packaged blankets arrive at the saw they are covered by a continuous wrapping such that common photoelectric cells or mechanized means of sensing the ends of blankets are not applicable. Because the blankets being wrapped vary in length, fixed timing of the cutting stroke is not satisfactory either. So, although the continuous wrapping process eliminates the problems of wrapping blankets individually, it requires that some special means be employed to trip the saw which cuts the wrapping.

Ends of blankets can be sensed by optical means before the wrapping is applied. The system developed uses a light source and photoelectric cell positioned ahead of the wrapping area on the packaging conveyor, *Fig.* 1. When a space between blankets passes this point, a signal is generated. This signal is then recorded by placing a permanent magnet on a steel belt conveyor supplied by Sandvik Steel Inc. The steel belt runs at the same speed as the wrapping conveyor so that when the end of the blanket reaches the saw the "magnetic messenger" reaches a limit switch which it trips to actuate the saw.

Several magnets are placed on the steel belt but held by a stop until individually released by signals from the photoelectric cell. After each magnet has tripped the limit switch, the magnet is carried back to the stop by the return run of the steel belt.

Thus the continuous wrapping which joined the blankets is automatically cut without damage to the blankets. Similar arrangements could be used in other processes where a remote or delayed action needs to be keyed to some earlier occurrence, particularly when intervals between the initiating occurrences are irregular.

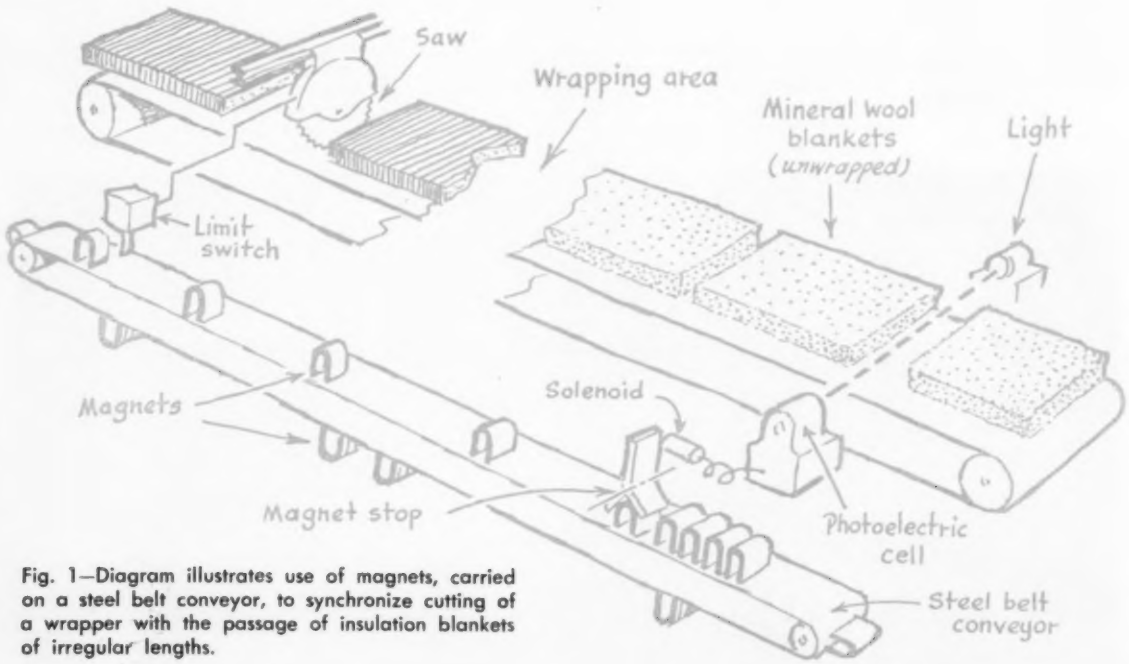
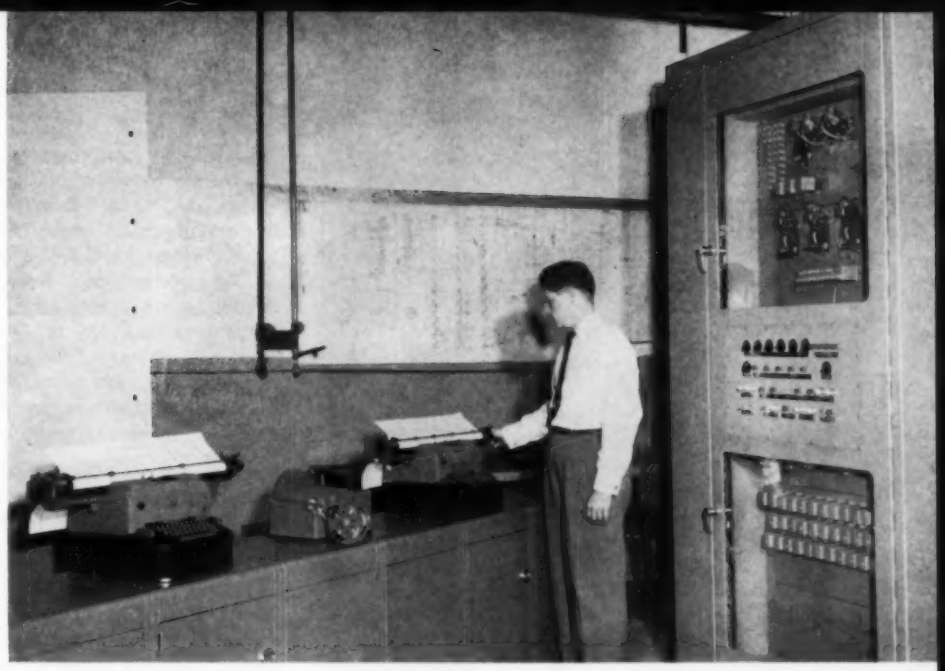


Fig. 1—Diagram illustrates use of magnets, carried on a steel belt conveyor, to synchronize cutting of a wrapper with the passage of insulation blankets of irregular lengths.



Automatic data logger similar to a system constructed for Esso's Belot, Cuba Refinery. Automatic typewriters print periodic information and the tape punch prepares 5 channel tape with production information needed in mechanized form by the accounting department.

DIALOGUE ON DATA LOG

In this article AUTOMATION uses a literary form established by Plato and with Plato's purpose—to clarify a proposition. Our proposition is that automatic data logging is a necessary step toward more complete automation, and our Socrates is Mr. W. F. Kamsler, chief systems engineer, Data Reduction and Automation Div., Fischer & Porter Co.

A DECISION to install an automatic data logger is important because it involves a great deal of time and money and is a departure from the normal instrumentation in an existing plant or test facility. Evaluation of automatic data logging in any process also involves plant layout, nature of inputs, amount of instrumentation and type of controls to be used. For these reasons, particularly in the construction of a new plant, it is important that a decision on the use of automatic data logging be made early in planning.

With this very brief background, you are invited to eavesdrop on an "early planning" conversation between a man with problems (perhaps you?) and a man with answers, Mr. William F. Kamsler, chief systems engineer, Data Reduction & Automation Div., Fischer & Porter Co.

To what extent should general management be involved in this decision relative to possible reduction in employees?

I wouldn't say that you are necessarily going to eliminate any people. This assumption that direct labor savings is implicit in the terms automatic data logging or automation is not often an important factor in the application of this equipment.

Other than this, management is directly concerned because one of the primary functions of an automatic data logging system is to digest vast amounts of information and give it to management as an operating tool. Much of the success of an automatic data logger is due to the help it gives to general management in making its decisions.

Difficulties and inaccuracies inherent in manual data recording are demonstrated in full measure by the task being performed here.

How much preliminary study of process requirements should precede a decision on installation of a logging system?

The importance of preliminary study is something that cannot be over-emphasized.

Many early logger installations failed to consider important factors in the process itself. For example, in the average plant today there may be several types of thermocouples, resistance thermometers and radiation pyrometers used as primary instruments to measure process temperatures. Economically it is important in installing an automatic logger that there be some uniformity in the types of primary instruments.

An outstanding feature of data loggers is time-sharing of various measuring components—recording on a single logger the measurements of many instruments at different times. The value of time sharing, of course, is lost if a variety of inputs from such primary instruments requires special and individual measuring components.

On what bases then are appropriate primary instruments selected?

The important thing is to establish as much uniformity among logger inputs as possible. Since a logger is an electrical device all inputs must be transduced into an electrical form in order to be measured. Therefore, the number of electrical ranges to be measured should be kept to a minimum.

Companies may set up engineering standards for primary instruments. For example, in regard to thermocouples, iron-constantan types may be used at from 0 to 1200F and chromel-alumel types may be used above 1200F. Actually, however, the iron-constantan type may be used at temperatures as high as 1800F and the chromel-alumel may be used as low as 0 degrees F. There is a very wide selection which depends very much on the judgment of the user and operating conditions.

Whether or not a thermocouple is to be used in a reducing or oxidizing atmosphere may also be a factor. Actually, a thermocouple in many locations may be replaced by a resistance thermometer, but a resistance thermometer would require a Wheatstone bridge to provide a millivolt output if it is used in a potentiometric measuring system.

In what other primary instruments besides thermocouples is uniformity important in setting up an automatic data logging system?

Temperature measurements are usually the most difficult to fit into a logging system because of the individuality of primary signals. Most companies manufacturing pressure transmitters maintain outputs within a pressure range of 3 to 15 psi, but several companies do make pressure devices that are a little different and therefore present some problems. Linear dc or ac inputs representing physical quantities offer no problems.

What are the considerations when installing a logger in an existing plant?

In most cases, an automatic data logger can easily be installed in parallel with existing instrumentation. Sufficient flexibility has been built into loggers presently marketed to accept inputs from ac or dc millivolt signals and standard 3 to 15 psi pneumatic transmission systems. Loggers generally are designed to operate in parallel with control elements without interference.

What basic questions must engineering people consider in evaluating and planning an automatic logging system?

Important information would include:

1. What sort of information is really needed?
2. Who wants to use the information after it is available?
3. How often must this information be presented to the operator?

Most loggers periodically present to the operators (usually once an hour) all required information. However, it is possible that the same information may be needed at other times. Thus, another decision that must be made is whether or not to use the logger as an alarm scanner and therefore use the log sheet as an annunciator or, instead, in combination with a separate annunciator. The logger can function as an excellent annunciator because it records the time of the abnormality, its location and the values of process quantities instantaneously. This is a definite improvement over the flashing light, particularly because a much better idea of the condition of the process is furnished at the time of the abnormality.

How are the process variables which are to be

logged determined in planning the system?

When a logger is to be installed in either a new or existing plant for an established process, the engineers can determine from their experience with the process what is most usefully recorded. On the other hand, a logger also is extremely useful in pilot plant work, where the recorded variables may be changed frequently and moved from point to point in the process.

Often engineers have not recorded a number of variables before introduction of the logger as a matter of economy. But once the central logging equipment has been purchased, the incremental cost of additional points may well be sufficiently low to justify logging marginal variables.

There is no economic justification for logging any variable, no matter how low the incremental cost, if the data are not going to be used. Therefore, in evaluating a process, it is good practice to review a detailed instrumentation chart of the process and double-check the usefulness of each instrument indication and recording. Does someone really need a particular reading or did someone only think he needed it? For example, a good deal of information may be used to operate an automatic controller but the only important indication necessary is that the controller is working properly.

Why is a time interval of one hour generally used in automatic logging?

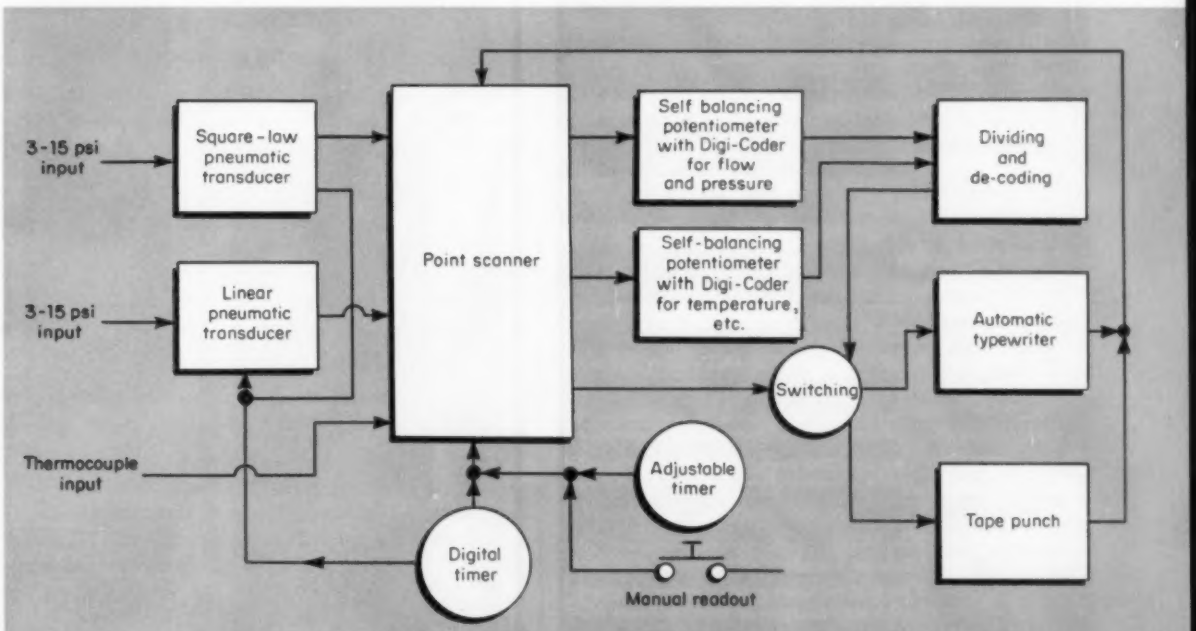
Use of a one-hour interval is a throwback to the days of manual data recording—an operator went from instrument to instrument recording data. Since it took about half a minute to make an entry, the number of instruments and particularly the logging interval sometimes prevented the operator from performing some other important duties.

Since time for manual logging is no longer a factor with automatic data logging, why is the one-hour interval still retained in automatic logging?

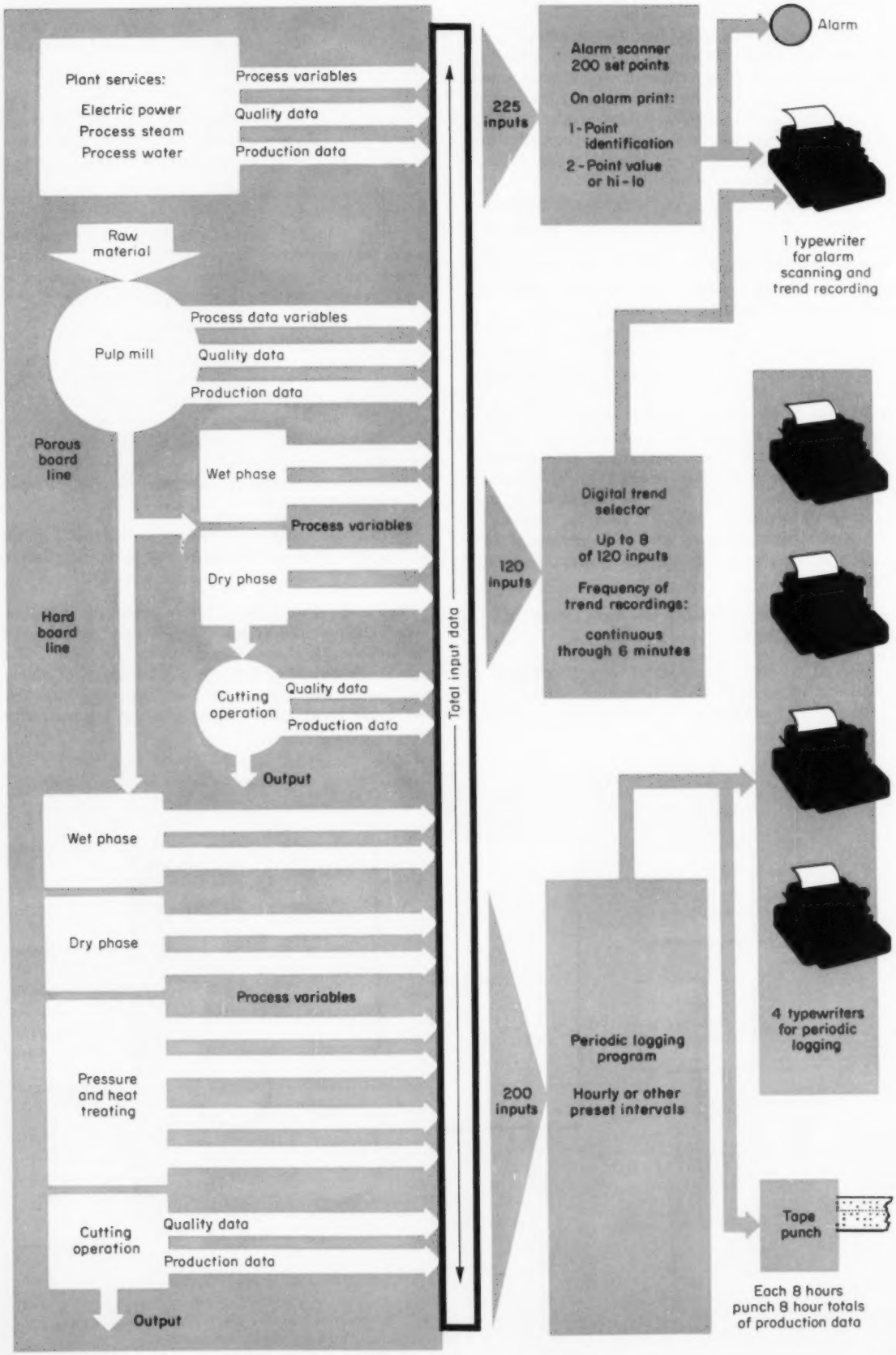
Automatic logging of information every hour is primarily a general-purpose review, particularly when process points are also logged whenever an abnormal condition occurs. Thus, the particular time interval is not critical. In addition, general management and the accounting department still keep records on an hourly basis, so it is certainly logical to maintain the same interval. However, the hourly log sheet as such is of virtually no use to production people who are responsible for operating the process. A possible exception to this might be when a new man or new shift arrives, the condition of the process at the last hourly check can be observed. Of course, if logging-on-demand is also provided, the new operator can get an immediate check.

Is the combination of automatic interval logging and alarm logging the most common installation today?

Yes it is. The periodic log is primarily useful to people behind the scenes. The alarm log becomes the operator's guide in controlling the plant. The operator's objective is to keep a minimum of alarm entries on this log. The fact that the operator no longer must make the rounds and log manually



Block diagram of an automatic data logging system. Note that the system receives analog signals and produces digital data output. Uniformity among types of signal inputs aids system simplicity.


Plant services:
Electric power
Process steam
Process water
Process variables
Quality data
Production data
225 inputs
Alarm scanner
200 set points
On alarm print:
1 - Point identification
2 - Point value or hi - lo
Alarm
1 typewriter for alarm scanning and trend recording
Raw material
Pulp mill
Process data variables
Quality data
Production data
Porous board line
Wet phase
Process variables
Dry phase
Hard board line
Cutting operation
Quality data
Production data
Output
Total input data
120 inputs
Digital trend selector
Up to 8 of 120 inputs
Frequency of trend recordings:
continuous through 6 minutes
4 typewriters for periodic logging
Wet phase
Dry phase
Process variables
Pressure and heat treating
Cutting operation
Quality data
Production data
Output
200 inputs
Periodic logging program
Hourly or other preset intervals
Tape punch
Each 8 hours punch 8 hour totals of production data

Data reduction and logging system for a paper board plant involves information on: Process variables including temperature, pressure, flow, electrical load, speed and level; quality data including hardness, strength, moisture, density, consistency composition, pH, and conductivity; and production data including unit input count, flow rate, integrated flow weight per unit time, electrical loads, and integrated electric power consumption.

gives him more time in process control which should result in a better product.

Are the alarm and periodic information usually logged on the same sheet and on the same points?

The alarm log sheet is usually separate from and includes a great deal more information than is on the hourly log sheet. The alarm sheet, for example, includes operating information like circuit-breaker operation, whether flow exists in various parts of the circuit, and other *Off-On* information which is not important to management and accounting. A particular control temperature might be critical but of no use on the periodic sheet. However, it could be purposefully alarmed if there should be any difficulty.

What then are typical operating factors which management and accounting might want on the periodic sheet?

Management and accounting are primarily interested in factors relating to yield of the process. Such questions might include:

1. How much product is being developed?
2. How much fuel is being used?
3. How much power is being used?

From these factors, efficiency, heat rates and such overall process factors or operating guides can be computed for use by management. This may be done either by including a small computer in the unit or by processing the information in a company central computer.

In test or pilot-plant data logging installations, the usual objective is to amass as much process information as possible for detailed analysis. The number, nature and location of the recorded data on the log sheet can be changed readily in a test or pilot-plant installation as the work is continuing. The output can remain in the same form—on a log sheet, punched tape, magnetic tape or punched card.

Since the flexibility of a logger and its use in process evaluation is a very important factor, what value has the logger in permanent installations on existing processes?

The value of a logger in a so-called permanent process lies in the fact that few such processes do not undergo changes, no matter how slight, which are designed to improve the product or operating efficiency. The important flexibility in an industrial process plant is in being able to change the range of an input, rather than the number or nature of the input. For example, assume that a process unit has been designed so that its operating pressure is in the range from 500 to 1200 psi. Advancements in process technology might prompt the company to plan an increase in pressure range from 700 to 1800 psi. With most pneumatic primary instruments, then, the new range of 700 to 1800 psi would provide the same pressure transmitting range of 3 to 15 psi as the original 500 to 1200 psi range. The digital output of the logger can easily be changed for the new range, without any change in the range of the input signal.

Who should be brought in on the planning of a logging system?

Engineering, production, general management and accounting should be involved. There will, of course, be different objectives for the logger from each of these groups. Production, for example, wants a rapid means of locating where the bottlenecks or inefficiencies are in the process. These can be more readily determined from a log sheet than by analysis of separate bits of operating information from conventional instruments.

The accounting department, on the other hand, is primarily interested in integrations or totals. Accounting has been accustomed to receiving data obtained with planimeters from round or strip charts. The inaccuracies of the planimeter in such work are well known. The accuracy of an automatic logger for totals is far greater than that done manually.

How is the information for each of these various departments presented on the log sheet?

The advantage of a log sheet is that carbons can be produced and the sheet can be specifically designed to meet each user's needs. By cross-hatched and partial carbons, each department can be presented only with the information of its particular interest. Normally, both general management and engineering are interested in all data for both production and accounting and therefore receive full sheets.

Engineering uses this information both in evaluating the process for development of improved or entirely new processes, and in observing the performance of present primary instruments in operation. Thus, temperatures, pressures and flows for a given process are much more conveniently used by the engineering department when recorded in adjacent columns. The accounting department is primarily interested in the flow, whereas production is concerned primarily with the operating pressures, temperatures, etc., that must be maintained in various sections of the process.

Most companies using loggers take advantage of this convenient form of recording. At the end of each day, each department receives a copy of the log sheet containing the information it is concerned with which serves as a permanent record. Formerly, operating data that was handwritten often had to be transcribed or photographed for

the use of particular departments.

How much new information has been made available by the loggers that could not have previously been made available in manual form?

The unique feature of a multiple function automatic data logger and alarm scanner is its ability to integrate and correlate measurements of all the processed parameters. The automatic data logger can present processed measurements more rapidly in a more usable form and additionally can compute or infer from multiple measurements, performance factors which are not directly measurable, such as process efficiency and material balance. It is this flexibility which gives the automatic data logger considerable advantage over conventional secondary instrumentation.

Does the potential user of an automatic logger have any effect on the design of the log sheet?

The log sheet itself is always designed in conjunction with the company's engineers. Provisions are usually made so that the arrangement or grouping of data on the log sheet can be changed to match new conditions and to include new measurements.

Since several departments use the logged process information, what personnel does the manufacturer of the logger work with in developing the system?

We work directly with the company's instrument engineers and may from time to time consult with persons in production, management and accounting.

Since four departments in a company may benefit from the use of an automatic data logger, how are the initial and operating costs of a logger allocated?

The production department usually assumes the entire cost of an automatic data logger in the construction of new processes. The benefit of the logger to production is the most tangible function of the logger until actual experience is attained in the other departments.

Production is always pressing for more and better products, faster and at a lower cost. Therefore, the engineering department evaluates temperature, pressure and flow data in the process to determine, for example, whether a pipe size in a particular location is too large or whether there is insufficient boiler capacity, etc. The engineering department might take the output on magnetic or punched tape and run it through a computer to determine the particular day (and set of operating variables) when the greatest product output was obtained for the least input. The second and third best day can be determined in the same manner. Thus optimum operating variables can be established.

Can you summarize benefits of automatic logging?

The logged readings are accurate, neat and legible. In addition, and perhaps most important, use of digital output avoids contending with analog measurements degraded through manual interpretation of graphs, manual integration, and final manual computation with all the costly inherent human errors possible. There is never the possibility of an operator taking what he considers to be an educated guess as to what the reading is without actually looking at an indicator.

Necessary calculations can be made automatically.

Automatic recording allows the operator to maintain proper supervision at all times, particularly during a period of stress.

The automatic logger will continuously and rapidly scan all variables upon which the safety and efficiency of the operation depends, and at hourly intervals or on-demand will print automatically the time and all pertinent values in correct sequence on a tabulated log sheet.

The automatic logger will, by alarm signal, call the operator's attention to an abnormal or upset condition and automatically print out the abnormal value or values in red, along with time of the abnormal condition. If required by the operator, it will also continue to print until the fault is rectified.

During such periods of stress, while the operator must give his full attention to rectification of the abnormality, the logging of variables will continue. This will give an accurate record of conditions during the upset period which is extremely valuable for study in avoiding such incidents.

By eliminating the need or replacing most of the indicators or graphic recorders, automatic data logging will save panel space, avoid chart changing and other recorder maintenance and will avoid the difficulty of interrelating one recorded variable with another on a different chart during examination and analysis of process conditions. Space requirements for the modern centralized control room are continually growing. Digital output of data reverses this trend and reduces or replaces the graphic panel, to a large extent providing all the necessary controls and data presentation in a space no larger than a standard executive type of desk.

Management will have readily available accurate data for accounting and other purposes. Designers will have reliable information for future design work.

Time sharing of most of the system components allows faster, higher quality, more reliable, more accurate devices to be used in the design of the automatic logger than could be economically justified for use in single analog devices.

The automatic logger provides these advantages in a compact system that is more accurate, more efficient, and requires less maintenance than conventional multi-instrument systems and at the same or lower costs. This is automation.

Plant engineers—here's two minutes *necessary* reading

G-E VOLTAGE STABILIZING TRANSFORMERS

TAKE THE LOSSES OUT OF YOUR PRODUCTION CYCLE

When you translate improper operation or equipment failure into terms of downtime and dollars lost, you come up with some very good reasons for stabilizing voltage. Conditions between source and load can cause voltage to vary as much as ten to fifteen percent. And in an automatic production cycle, varying voltage at the load seriously affects the operation of sensitive equipment. Thus, fluctuating voltage can cause improper operation of equipment or equipment failure.

Economical Voltage Stabilization

For most applications, voltage stabilizing transformers provide the most economical way to stabilize voltage at the load. The General Electric Company manufactures a complete line of these voltage stabilizing transformers which absorb the ups and downs of input voltage, and deliver stabilized output voltage to the load. Standard G-E voltage stabilizing transformers connected to an ordinary power-supply line can stabilize up to a 30% change of voltage to plus or minus 1% within 1½ cycles.

Automatic Voltage Stabilization

Stabilizing voltage with G-E voltage stabilizing transformers is completely automatic—no dials to set—no moving parts; no relays or tubes to cause maintenance problems. Simply connect the right G-E voltage stabilizing transformer on the line, and as the input varies, the output is held steady. Other features of these G-E voltage stabilizing transformers include: smaller size, reduced weight, primary-secondary isolation, built-in voltage transformation, rapid response, low stray-field intensity, wide input voltage range.

Before You Invest in Stabilizing Equipment

Unquestionably there are many ways to stabilize voltage. The type of stabilizing device that should be employed, of course, is the one that will provide the most economical stabilization to a satisfactory degree. That's why before you make *any* investment in more expensive voltage stabilizing equipment, make certain you investigate General Electric voltage stabilizing transformers by contacting your local General Electric Apparatus Sales Office or distributor. Or send for a special bulletin on G-E voltage stabilizing transformers by mailing the coupon below. General Electric Company, Schenectady 5, N. Y.

Send for Free, Illustrated Bulletin!

Section C410-24
General Electric Company
Schenectady 5, N. Y.

Please send me GEA-5754B, Voltage Stabilizing Transformers

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STREET .....

CITY ..... ZONE ..... STATE .....

GENERAL ELECTRIC

PLANET DESIGNED TUBE HANDLING SYSTEM
Floats Excess Stock

This Planet system, which was recently installed in an auto plant, automatically handles frame members from tube forming to assembly. Its outstanding feature is the stacker illustrated which provides an automatic float for tubing formed in excess of immediate production requirements. In this installation, the stacker accumulates and bands the tubes on dollies for live storage. This permits efficient use of the forming equipment at timed intervals, while supplying assembly with a steady flow of tubes.

A system of this kind would work equally well for any uniform stock, such as bars, rods or billets. Perhaps it might solve a problem in your plant. Let Planet demonstrate how it can help you. *Write or phone today — there's no obligation.*

PLANET CORPORATION

1810 SUNSET AVE., LANSING, MICH.

- **ENGINEERED HANDLING SYSTEMS**
- **AUTOMATED EQUIPMENT**
- **FOUNDRY HANDLING SYSTEMS**

66

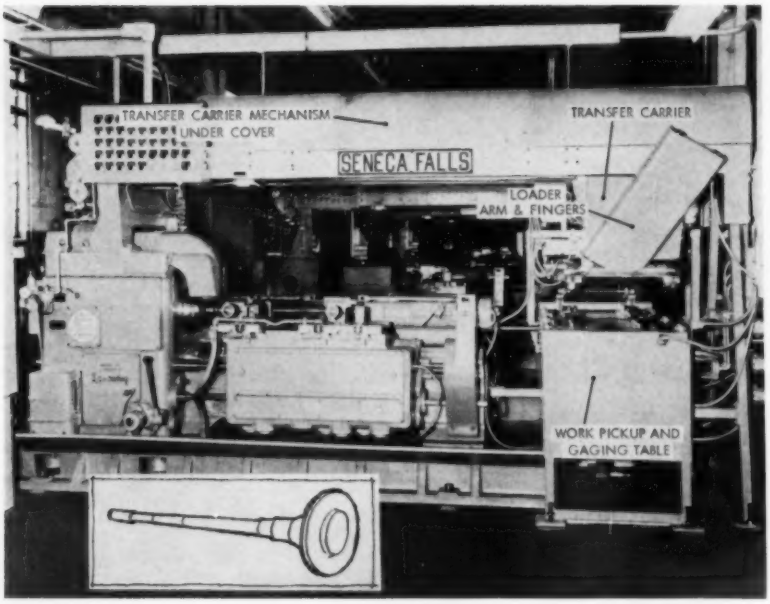
Circle 588 on Inquiry Card

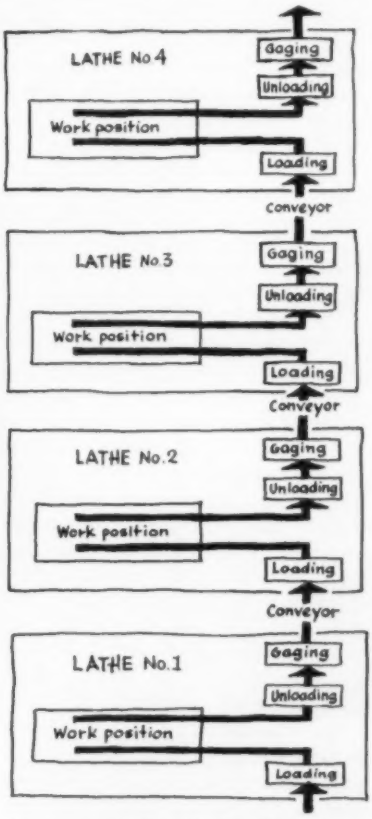
AUTOMATION

new equipment

Machines and plant equipment designed for more automatic operations

For detailed information and literature, use card page 17





Processing Rear Axle Shafts Automatically

An automatic lathe setup which includes in-process gaging and handling has been designed by **Seneca Falls Machine Co.**, Seneca Falls, N. Y., for the processing of rear axle shafts at a rate of 180 per hour. The installation is composed of four Model AR Lo-swing lathes with chip flow beds, each complete with necessary tooling; automatic gaging station; work transfer and work loading equipment; conveyor; mechanized chip conveyor, and control panel for co-ordinating the movements of the loading and transfer equipment.

Sequence of Operation

Each lathe has a transfer carrier which moves back and forth, between the work position and machine loading stations, on overhead rails which are under an enclosure which also houses the transfer drive mechanism. This mechanism as well as the loader arm and fingers are mechanically operated and positive in action.

In operation, the rough axle shaft forgings arrive by chain conveyor at the pickup and gaging table, one of which is attached to the tailstock of each lathe. The rough parts are automatically dropped into shuttle cradles which are mounted on endless chains operated in a shuttle movement. The transfer carrier is positioned just over the pickup table and the rough shaft is elevated by cradles into the loader arm fingers which close on contact with the shaft. The transfer carrier then moves forward to the work position; the unloader arms descend; the unloader fingers grasp the finished axle shaft; the tailstock center retracts and the unloader arm returns to the retracted position. The loader arms with the rough shaft then descend to the center line; the tailstock center advances to support the shaft; the finger latch is tripped by the tailstock quill to release the fingers, and the loader arm returns to the relieved position.

The headstock spindle clutch is then engaged and the machining part of the cycle begins. The transfer carrier returns to the pickup position at which point two sets of elevator cradles are raised. One set loads a rough part to the loader fingers. The unloader fingers are unlatched, and the finished shaft is released into the other set of raised elevator cradles. The transfer carrier again moves forward to loading position and the entire cycle is repeated.

In the meantime, the loading

station cradles move to receive a rough shaft, while the finished shaft is raised from the unloading station cradles by a gage elevator cradle and thrust into the gaging station.

In-Line Tolerance Check

The gaging instruments indicate by means of dimensional signal lights whether the points of inspection are oversize, undersize or within tolerance by means of green, red, and a blackout of lights, respectively. When all diameters inspected are within the specified tolerance, the workpiece is automatically released from the gaging station and deposited on the chain conveyor. If the part is oversize or undersize, the workpiece remains in the gaging station and the machine that produced the off-tolerance piece stops automatically at the end of the machine cycle.

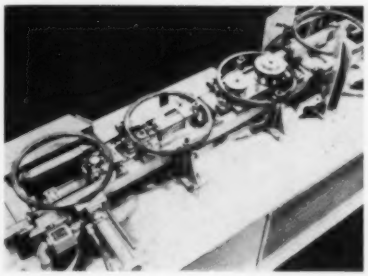
The equipment furnished with the other three machines in the four-unit installation is identical, with the exception of the actual cutting tools, tool holders and machine attachments. The machines are sufficiently spaced to permit easy access for tool changing and also to provide space for the endless chain type conveyors, furnished by the customer, for conveying and providing a bank of parts between each machine.

Significance for Automation

In discussing the new installation, Mr. E. R. Smith, president of Seneca Falls Machine Co., stated, "The key significance of this development for automation minded production men is that these machine tools are designed to perform their own in-process handling and gaging as integral parts of their automatic cycle. This concept provides for the establishment of automated production lines with the minimum of additional equipment." Other advantages of this type of production are:

1. Mechanical handling eliminates operator fatigue.
2. Automatically controlled machining and handling time reduces labor and unit costs.
3. Automatic gaging as each piece leaves the machine improves quality control.
4. Work spoilage and salvage expense are reduced.
5. Damage to parts which frequently occurs with hand loading is eliminated.
6. Number of operators required for a production line is reduced.
7. Accidents caused by the limitation of human reflexes are reduced.
8. Straight-line conveyor feeding simplifies plant layout.

Circle 401 on Inquiry Card



Ring Gear Straightener

Fully automatic ring gear straightening of 14-inch diameter flywheel gears is accomplished at rates of 400 per hour on new machine. The machine rounds up the rings from 0.060-inch out-of-round to under 0.007-inch total indicator reading. It can process ring diameters ranging from 12 to 16 inches. The theory of the straightening system can be applied to a wide range of diameters, depending on the ratio of diameter to thickness.

In operation, parts are fed from the loading magazine to a walking beam conveyor which carries them through the straightening station, gaging station and exit station. Gears which fail to meet gaging acceptance after straightening are automatically rejected to the side of the machine. **Cargill Detroit Corp.**, Birmingham, Mich.

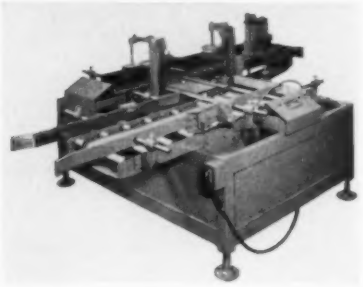
Circle 402 on Inquiry Card

Press Transfer Unit

Designed for removing, transferring and loading parts from one work station to another, punch press transfer machine features accurate orientation of the workpiece in the loading operation. Although primarily designed to handle work from one punch press to another,

the machine can be tooled for a variety of parts handling operations. Standard models have an adjustable stroke 42 inches long and 8 inches high. Longer strokes are available on special order. The horizontal motion of the machine is obtained by mechanical linkage through an adjustable electric clutch and brake control. **Automation Development Corp.**, 135 Reynolds Rd., Mentor, O.

Circle 403 on Inquiry Card



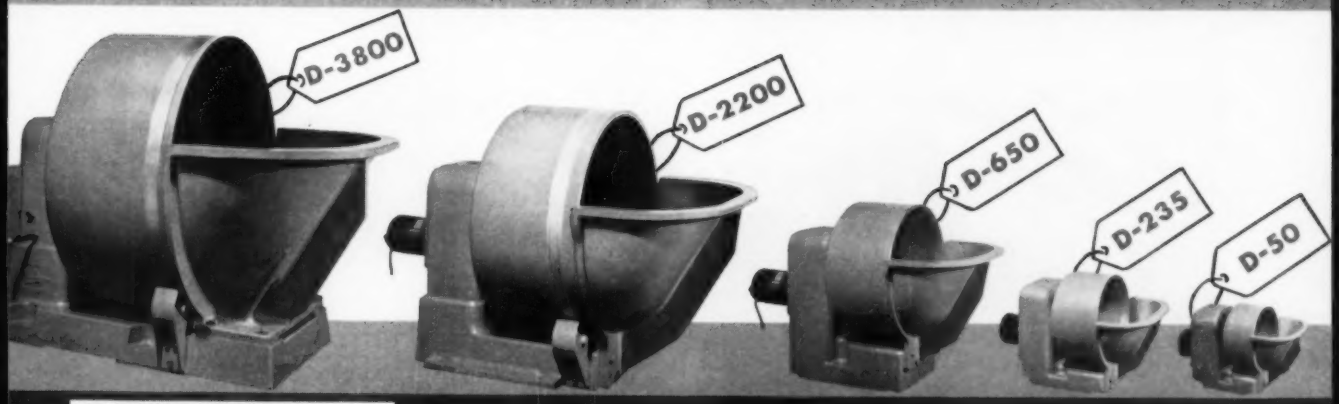
Case Imprinter

Developed to answer a need created by developments in automatic palletizing methods which make it essential that corrugated shipping containers show name and contents on all sides for ready warehouse identification, completely automatic case imprinter imprints name and contents on four sides and imprints a product serial number. The machine imprints on two panels and two ends without manual positioning.

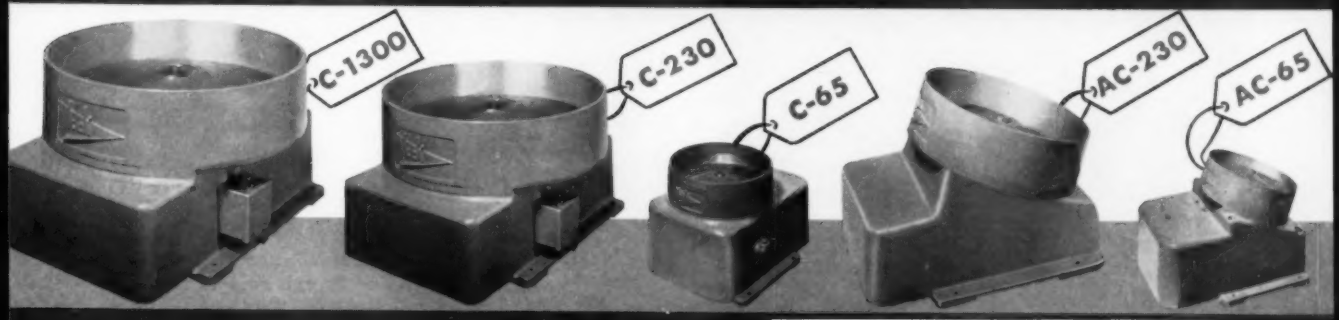
Flexibility of the imprinter makes it adaptable and practical for all industries using corrugated shipping cases, regardless of the contents of the case. The machine prints from one to eight lines within a printing range 11 inches high. Type may be graduated from ¼ to 1½ inches high. The serial numbering device prints to six digits in figures up to 1½ inches high. **J. L. Ferguson Co.**, Joliet, Ill.

Circle 404 on Inquiry Card

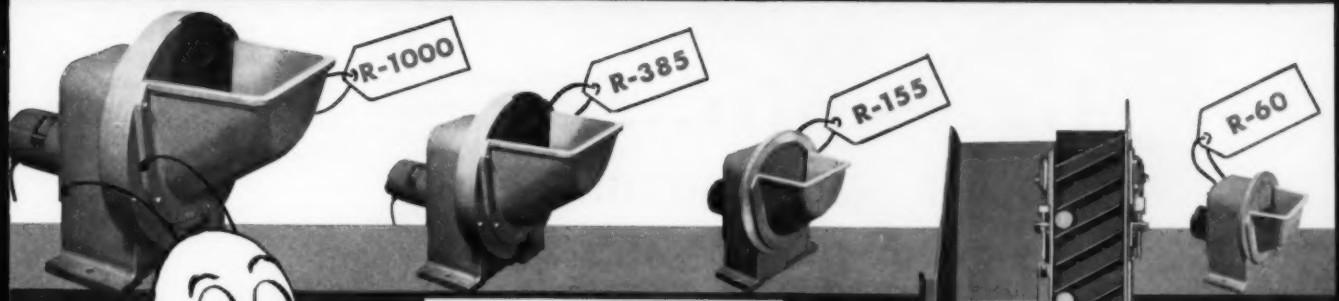
Circle 589 on Inquiry Card→



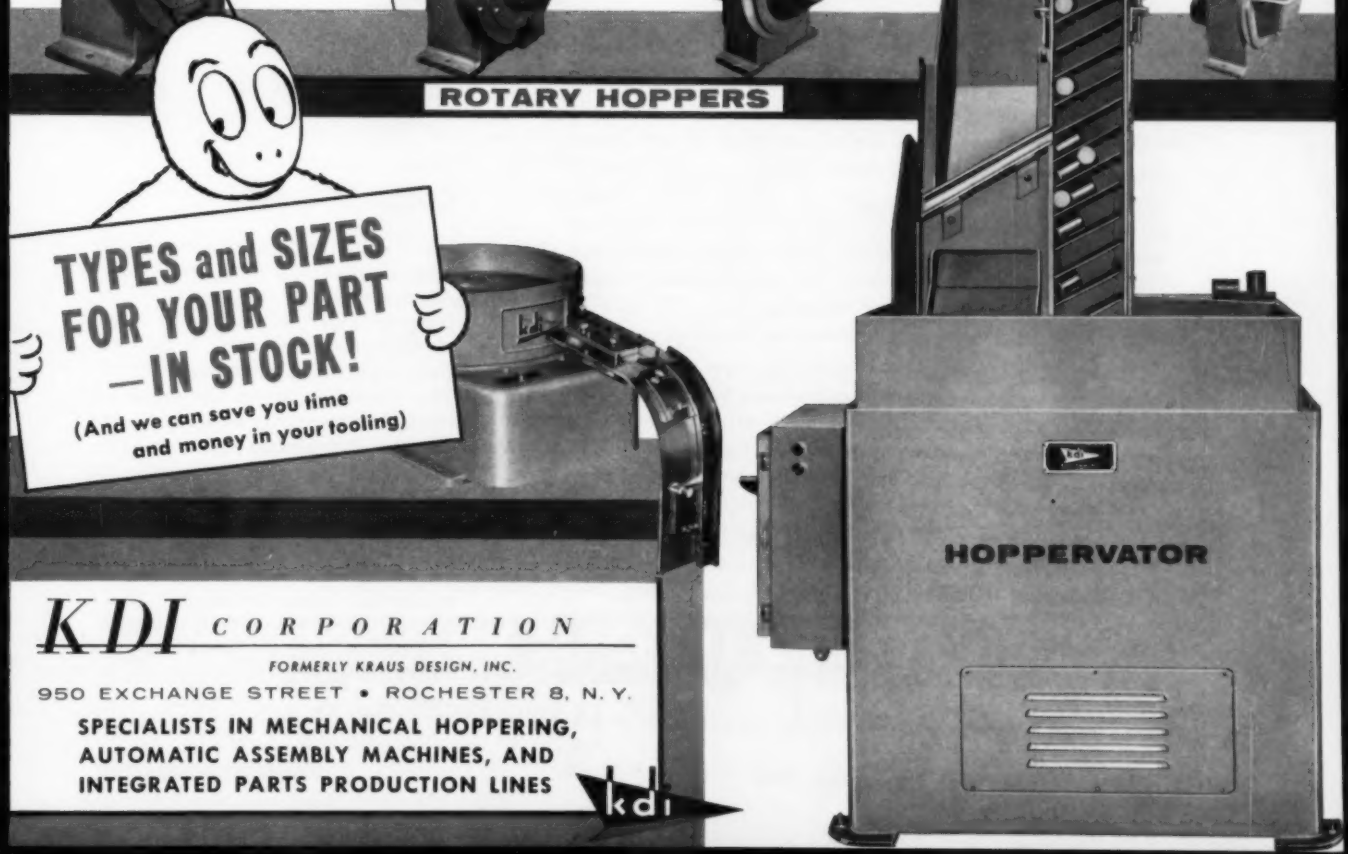
DRUM HOPPERS



CENTRIFEED HOPPERS



ROTARY HOPPERS



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FORMERLY KRAUS DESIGN, INC.

950 EXCHANGE STREET • ROCHESTER 8, N. Y.

SPECIALISTS IN MECHANICAL HOPPERING,
AUTOMATIC ASSEMBLY MACHINES, AND
INTEGRATED PARTS PRODUCTION LINES

kdi

In a spin...

over automation possibilities for your plant?

To develop a truly *profitable* automation program, the "integrated approach" becomes of compelling importance.

For example, future trends in *consumer demand* may quickly obsolete costly automated equipment. These need to be carefully investigated. *Product redesign* may be called for, to achieve greater standardization of basic components and maximum cost savings. Design of special *automatic machines* or *flexible material-handling* equipment may be needed. *Central control mechanisms*, which monitor the operation of an entire plant, can open up entirely new possibilities in truly automatic production.

Because of our specialized engineering experience in these complex areas, Designers for Industry can provide a broad "horizontal" view of automation possibilities in *your* plant. Through our Creative Engineering approach, backed by highly co-ordinated technical skills, we can help you develop an *integrated program* for achieving maximum benefits from automatic production.

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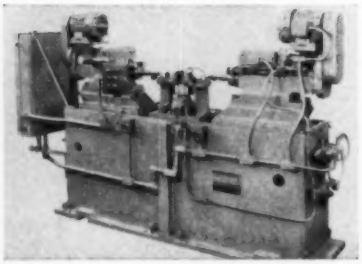

Spaced Hole Driller

Model 350-S machine drills two, five or six equally spaced holes arranged in a circular part. Selection of the number of holes to be drilled requires only the setting of an index selector switch.

Two Morris Air-Oil-Matic drill units and an air-operated indexing fixture are the basic components of the machine. They are interlocked in a variety of automatic cycle combinations to obtain the hole patterns required. The drill units offer adjustable feed rate, feed stroke and total stroke, with a wide range of spindle speeds. Drill sizes range to 5/8-inch diameter. **Morris Machine Tool Co.**, 933-17 Harriet St., Cincinnati 3, O.

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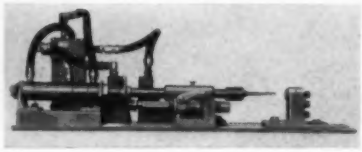


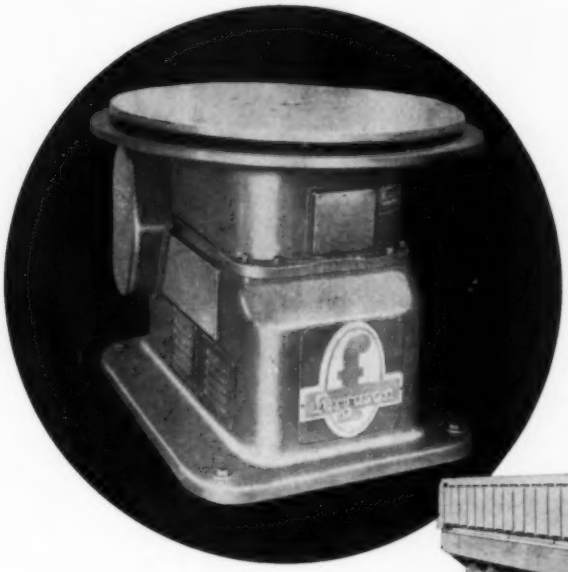
Cable Stripper

Available for production stripping of metal braid on any standard size coaxial cable, machine features a single air valve which actuates the reciprocating braid cutting motion in an automatic cycle. The machine can be operated at production speeds with inexperienced and unskilled workers. The unit takes less than 3 seconds in production operation to make a clean, square-shouldered cut. The machine is applicable for use in electrical, electronic and nuclear equipment manufacturing. Illustrated bench model measures 6 7/8 by 10 by 26 inches. **Wire Stripper Co.**, 1729 Eastham Ave., E. Cleveland, O.

Circle 406 on Inquiry Card

Circle 590 on Inquiry Card

Your Answer to the High Cost of Converting to Automatic Assembly



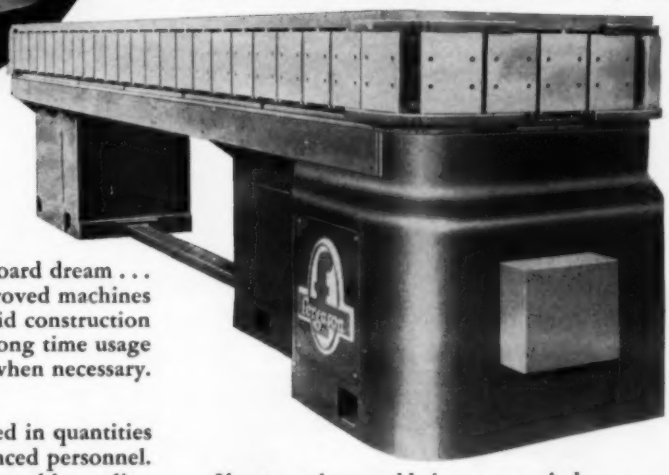
STANDARD

Ferguson

ROTARY and IN-LINE

Transfer Machines

... Save Design
and Manufacturing Costs
... Can Be Re-Tooled when Required



BECAUSE:

1

They are more than a drawing board dream . . . the Ferguson bases are real and proved machines with the versatility, rigid construction and low maintenance that permit long time usage and re-tooling when necessary.

2

Ferguson machines are produced in quantities and assembled by experienced personnel. They cost less than a special base of comparable quality.

3

Ferguson machines are standard. Parts can be interchanged or replaced. Costly design time is reduced and delivery time is shortened. No "de-bugging" is required.

4

There is a wide range of standard Ferguson bases. One will meet your requirements with little or no compromise with optimum working conditions.

5

Ferguson bases give you smoothness of operation and accuracy of parts location because they include the famous Ferguson Drive, acknowledged to be the ultimate in high speed, precision indexing mechanisms.

6

Our competent engineering staff, including field engineers in principal cities, can give you genuine assistance in selecting the proper base for your application.

If automatic assembly is on your mind — for either now or in the future — it will pay you to get the facts from Ferguson.
Write for our literature or ask for an engineer to call. There is no obligation.

CATALOG 301

Complete data on Ferguson Index Tables and Rotary Transfer Machines; 26 pages of information; lists tables available from stock for immediate shipment.

BULLETIN 401

Describes the Ferguson Trans-o-Mator, standard multiple station in-line transfer machine for automatic assembly.

TOOLING DESIGN SERVICE

Our Hicks Development Division can design and build a complete automatic assembly machine for you, using our standard bases. Bulletin No. 500 shows many such installations. Write for a copy.

ferguson

FERGUSON MACHINE CORPORATION OF INDIANA

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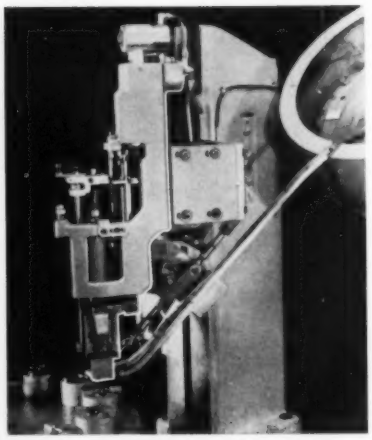
Extensive Logan floor type and trolley conveyor system provides flow production in RCA's Bloomington, Ind., television plant. Here, chassis arriving via Trolley Conveyor are installed in cabinets and adjusted along Slat Conveyor assembly line. Conveyor declines, as shown, to convenient working height.

The LEADERS use Logan

. . . to keep things moving, in the modern industrial plant. Costly stops and starts are avoided—with correctly engineered Logan Conveyors. This famous equipment delivers materials and parts at convenient working heights, dispatches the product without manual effort to the next operation, puts flow into production. "Stay with the leaders—specify Logan Conveyors." Remember, they give you that something extra in engineering and design. Write for further information or for nearest engineer to call.

LOGAN CO., 218 CABEL ST., LOUISVILLE 6, KY.

Logan Conveyors



Parts Positioner

Capable of accurately guiding a variety of piece parts automatically from feeder track to fixture, automatic parts positioner is designated Model PR-3. The automatic cycling unit handles parts ranging from 1/16 to 3-inch OD at rates up to 7200 per hour. It may be nested on 3-inch minimum centers along an in-line transfer table or may be located at adjacent stations on a 5-inch radius dial indexing table having as many as 12 stations.

Full electrical controls are included, with provisions for automatic interlocking. The positioner also serves as an efficient sensing device. If a part is missing or improperly placed, the machine stops automatically with the ram in forward position, making it a simple matter to find which head failed to perform its proper function. The timing is such that the positioning punch may advance far enough to control the work in the placement chucks. From this point, the positioning punch and chucks move together, controlling the part without gravity assistance. The chucks stop at the proper level above the fixture and automatically open while the positioning punch continues its advance to place the piece. **Dixon Automatic Tool Inc.**, 2300 23rd Ave., Rockford, Ill.

Circle 407 on Inquiry Card

Twin Hearth Furnace

Developed to process up to 800 lb of work per hour, Model 242 Shaker Furnace features automatic operation and twin hearths. Two

Automate

A STEP AT A TIME

The pot of gold at the end of the automation rainbow seems far beyond the reach of many a manufacturer when he thinks of the capital investment required to build an automatic factory.

But he can take it step by step with minimum capital investment, and without loss of time.

Most of the needs of automation can be met by the application of simple control mechanisms coupled with a measure of ingenuity.

The Bellows Co. manufactures control mechanisms to turn standard machines and machine tools into high production automatic units. When desired, we'll even furnish the measure of ingenuity!

Phone your local Bellows Field Engineer, ask him to sit down with your production men. No cost. No obligation. Automate step by step.

Take this step, first–

Write for a copy of Bulletin ML-3. In its pages are ideas you can quickly put to use. No cost. No obligation. Address Dept. AU-557, The Bellows Co., Akron 9, Ohio. In Canada, Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ont.

Over 125 technically trained Bellows Field Engineers in the United States and Canada are at your service.

The Bellows Co.

AKRON 9, OHIO

MANUFACTURERS OF CONTROLLED-AIR-POWER DEVICES FOR FASTER, SAFER, BETTER AND **LOWER-COST** PRODUCTION

772-8

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Guarantee ***TOP*** *Performance and Maximum Life!*

Specify THESE TOP QUALITY FEATURES...

(Standard on Miller Cylinders at no extra cost)

Specify CASE HARDENED CHROME PLATED PISTON RODS

On all Air and Hydraulic Cylinders

Benefits To You

CASE-HARDENED Piston Rods (52-54 Rockwell "C") provide practically complete protection against damage from hammer blows, wrench-dropping, mishandling, and similar occurrences. ***Available from Miller at no extra cost.***

The HARD CHROME PLATING over the case-hardened rods protects against scratch-damage and rust. ***Available from Miller at no extra cost.***

Specify "TEFLON" WIPERS

On all Air and Hydraulic Cylinders

Benefits To You

"TEFLON" Rod Wipers and "TEFLON" Hydraulic Piston Rod Seals withstand temperatures from—100°F. to plus 500°F. They are impervious to practically all known chemicals, including the fire-resistant, special, and standard hydraulic fluids in current use. ***Available from Miller at no extra cost.***

Specify TEFLON HYDRAULIC ROD SEALS

On all Hydraulic Cylinders

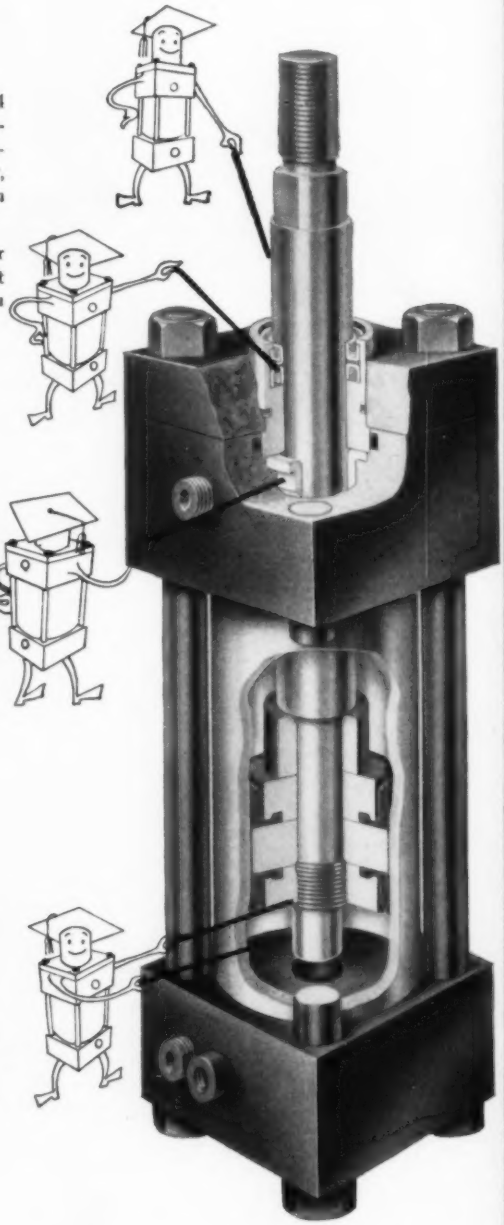
Specify RUST RESISTANT SURFACES

On all Air and Hydraulic Cylinders

Benefits To You

Highest quality Black Ferric Oxide Finish provides rust protection in air cylinder operation and on all cylinders during shipping and installation.

Cylinder heads, caps, mountings, pistons, followers, tie rods, and the unplated portions of the piston rods have this finish ***at no extra cost on all Miller cylinders.*** (This finish not recommended for water service)



NOTE: On all Miller Hydraulic Piston Seals: Leather Cup Seals are *standard,* Piston Ring Seals are optional at no *extra* cost and "Teflon" Cup Seals are available at *extra* cost.

You may wish to route this entire page to the proper department in your company, by using this handy form. Additional copies on request. →

To (Dept.)_____

"On all our future cylinder requirements, please specify the above quality features."

Signed_____

Title_____

Member of the National Fluid Power Association

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Miller

MILLER FLUID POWER DIVISION
FLICK-REEDY CORP.

2015 N. Hawthorne Ave., Melrose Park, Ill.

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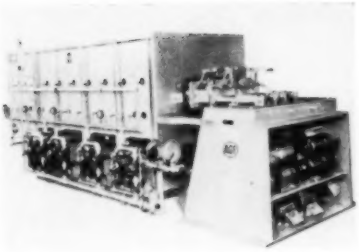
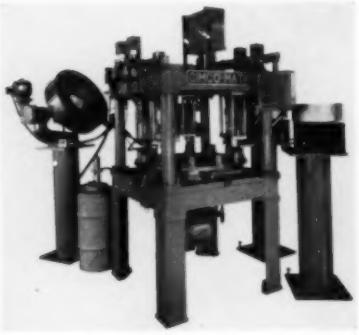
AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS



parallel sealed hearths are mounted in the furnace to double the heat treating production of the same work, or to heat treat two different types of parts which require the same atmosphere for processing at the same or different time cycles.

The complete furnace is constructed to be readily adaptable to production line installation and need not be confined to a furnace room. Each hearth is individually controlled for operating speed; work advances automatically by the regularly interrupted reciprocating movement that carries the work through the controlled atmosphere. **American Gas Furnace Co.**, 834 Lafayette St., Elizabeth, N. J.

Circle 408 on Inquiry Card

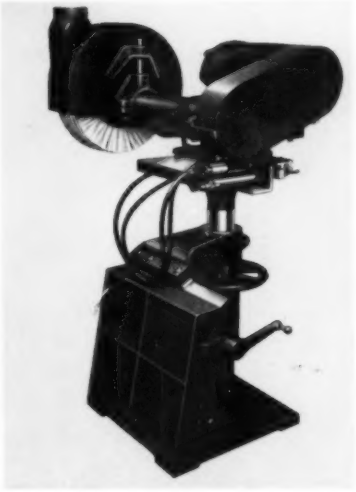


Bearing Assembly Unit

Developed for putting together automotive bearing assemblies, machine includes a Model MDA24 LT 12 station index table with a special 36-inch dial plate; pneumatically operated work stations; and an electrical control system. The machine produces 900 complete assemblies per hour with one operator.

All work stations are designed around standard tooling support units suspended from the top plate, permitting modification for minor part changes. On major part changes, the units can be relocated and modified to give a different sequence of operation. **Cimco Engineering Co.**, Ann Arbor, Mich.

Circle 409 on Inquiry Card



Traveling Head

Designed for use on straight line conveyors and on certain continuous rotary automatic applications, traveling head for buffing work is identified as Model 50-108. The head travels with the work, providing more buffing time on areas that are difficult to reach.

As the work approaches the wheel, an air cylinder is energized for forward stroking. The stroke is variable up to 5 inches. At the end of the stroke, the air cylinder returns the head to pick up the next piece of work. The speed of travel can be synchronized with the conveyor speed through a hydrocheck cylinder which is also used to provide smooth forward movement.

A dovetail way provides horizontal adjustment and a handwheel is used for vertical adjustment of the column. The head can be rotated 360 degrees around the column and is readily positioned to the work. It can be used with buffs, setup wheels, abrasive belts, and wire or tampico brushes. **Hammond Machinery Builders Inc.**, 1650 Douglas Ave., Kalamazoo, Mich.

EACH PART OF A LOVEJOY UNIVERSAL JOINT IS PRECISION GROUND AND PERFECTLY FITTED

Lovejoy Universal Joints are precision-built for tough service . . . are light-weight, quick-acting to give sensitive response and smooth performance.

Compact construction makes them ideal for close quarter operation. Simplicity of design and absence of complicated parts assure dependability, long life and negligible maintenance.

Lovejoy's full line of standard sizes can provide you with the universal joint that is *just right* for any slow speed application. Special units can be made to individual specifications on request.

Standard sizes range from fractional to 207 hp., diameters ½" to 4", bores ¼" to 2", lengths 2" to 10⅝".

Contact Lovejoy now for complete information. Request bulletin.

LOVEJOY FLEXIBLE COUPLING CO.

4806 W. LAKE STREET • CHICAGO 44, ILLINOIS

Mfrs. of Flexible Couplings, Variable Speed Pulleys and Transmissions, Motor Bases and Universal Joints.

Circle 678 on Inquiry Card

New Westinghouse Life-Line H with silicone insulation

10 TIMES LONGER INSULATION THAN ANY OTHER STANDARD

Production Increases with Life-Line® "H" because you get top performance – reduced maintenance and down time. Here's how:

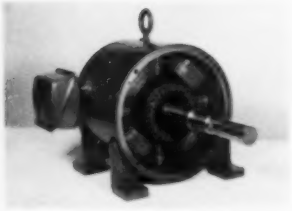
High-Temperature Silicone Insulation combined with the full complement of iron and copper for low-temperature standards – 60°C rise. Life-Line "H" insulation will last 10 times longer than ordinary Class B under all temperature conditions.

Controlled Ventilation – a new concept in motor cooling and cleaning – gives more capacity, longer life, and protection against damaging brush dust.

Fastest Response of any industrial d-c motor on the market – armature inertia reduced up to 55% – commutating ability increased 35%. You get closer regulation, faster accelerations, quicker reversals.

Greatest Protection of any industrial d-c motor through new housing design. In most cases, eliminates need for a splash-proof motor.

It's All New – with longer life, greater dependability, top performance. For all the facts about the Life-Line "H" call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21990



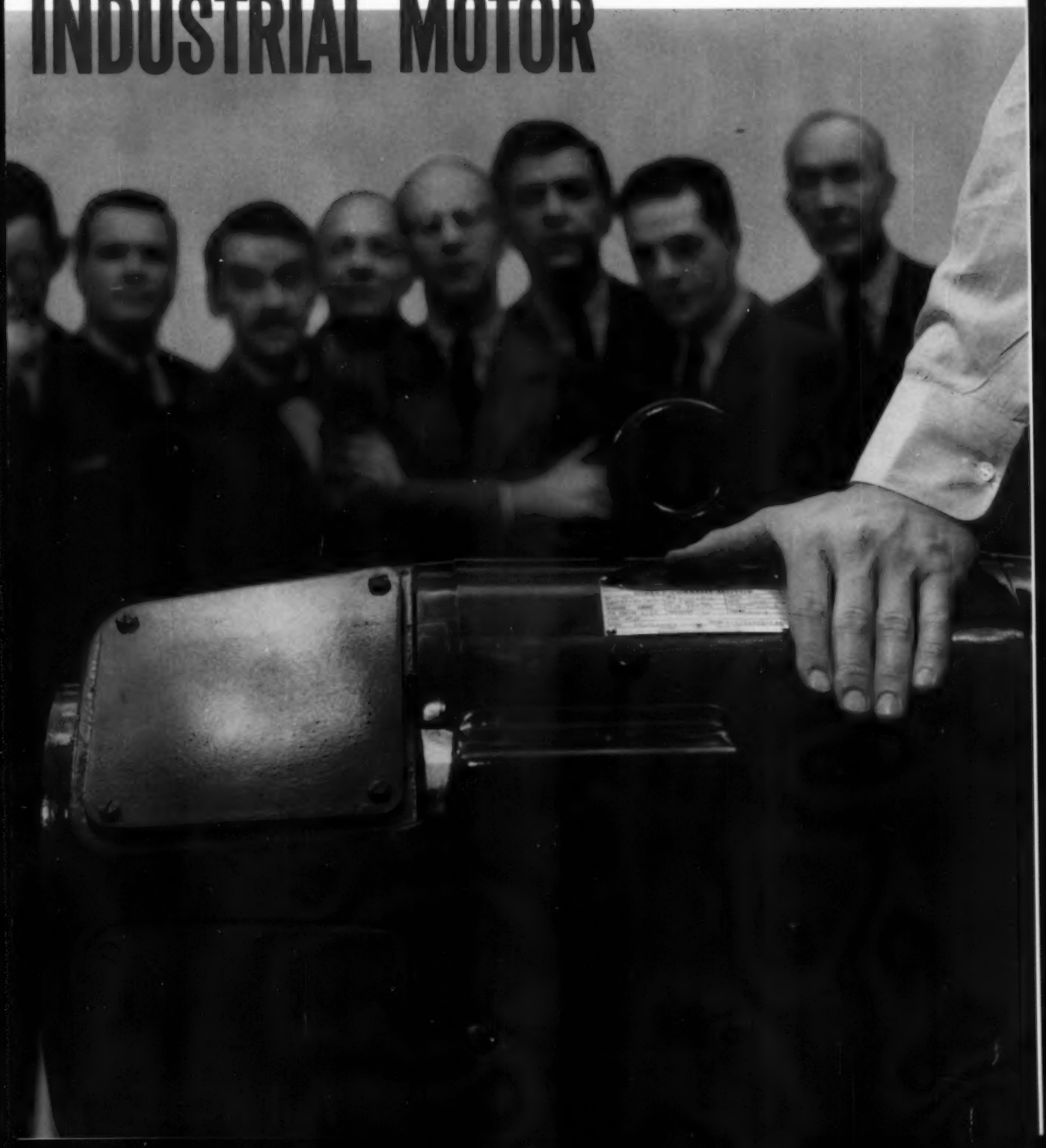
New Silicone-Insulated Life-Line "H" is built and rated to meet low-temperature Class B standards. Insulation is eliminated as a limiting factor on motor life under normal conditions. Even with emergency overloads, Life-Line "H" will go right on working in many cases when ordinary Class B would fail.

New Controlled Ventilation moves more air, positively distributes it to best advantage, cleans machine parts instead of contaminating them. Result – armature inertia can be reduced for faster response. Life-Line "H" lasts longer, increases production because maintenance and down time are reduced.

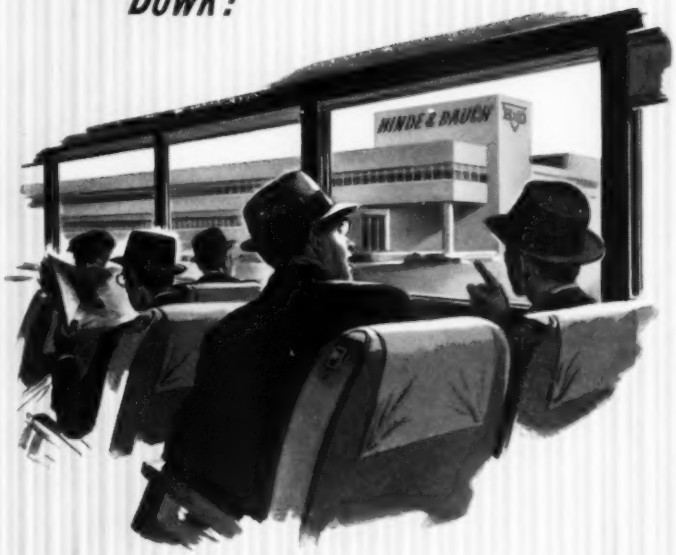
New Standard of Protection – All commutator access openings have sealing covers – ventilation openings face down. Dripping or running liquids are excluded. Maintenance and down time are reduced. Need for splash-proof machines eliminated in most cases.

YOU CAN BE SURE...IF IT'S Westinghouse

LIFE...MORE EXTRA-CAPACITY INDUSTRIAL MOTOR

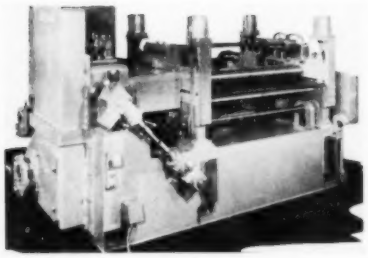


"Dowk?"



We realize Hinde (rhymes with find) and Dauch (pronounced 'dowk') are difficult names to pronounce.
We also answer to "H & D."
Call us next time you need corrugated boxes.

HINDE & DAUCH
Subsidiary of West Virginia Pulp and Paper Company
AUTHORITY ON PACKAGING • SANDUSKY, OHIO
14 FACTORIES • 42 SALES OFFICES



Press Feeder

Mechanically controlled, completely automatic feed line for either blanking or progressive die presses is designed to feed lengths as long as 60 inches of 0.125-inch by 60-inch wide stock. Composed of a coil holder, a decoiling unit, a mechanically controlled feeder unit, and, in cases where a scrap skeleton must be disposed of, a scrap shear, the line is applicable without modification to both progressive die operation and straight blanking work. The equipment is electrically synchronized with the press.

For progressive die stamping, the feeder unit has built-in roll release and anti-backup rolls. When needed, the scrap shear is placed on the exit side of the press, its entry feed rolls synchronized mechanically with the press feeder by a line shaft. Every unit of the line is electrically interconnected, creating a completely synchronized, automatic press feed line. **McKay Machine Co.,** Youngstown 1, O.

Circle 411 on Inquiry Card

Assembly Machine

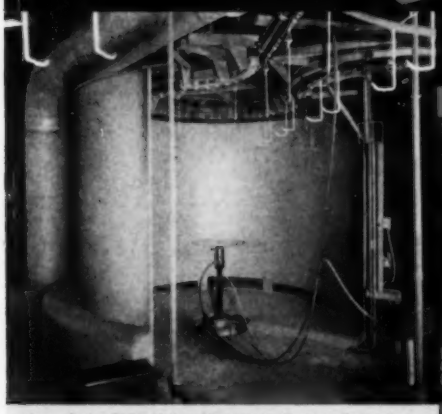
Assemblies and subassemblies requiring drilling, tapping, screw inserting, peening, pressing, crimping, etc. are handled by Model 100 machine. The assembly machine is used in electrical, hardware, toy, jewelry, and similar industries. Illustration shows a section of the Model 100 built for a jewelry finding house. This machine taps, inserts screws, feeds parts, swedges, and ejects the finished assembly.

The production rate of the manually actuated unit built for the illustrated application is 30 per minute. The degree of automation used and output rates depend

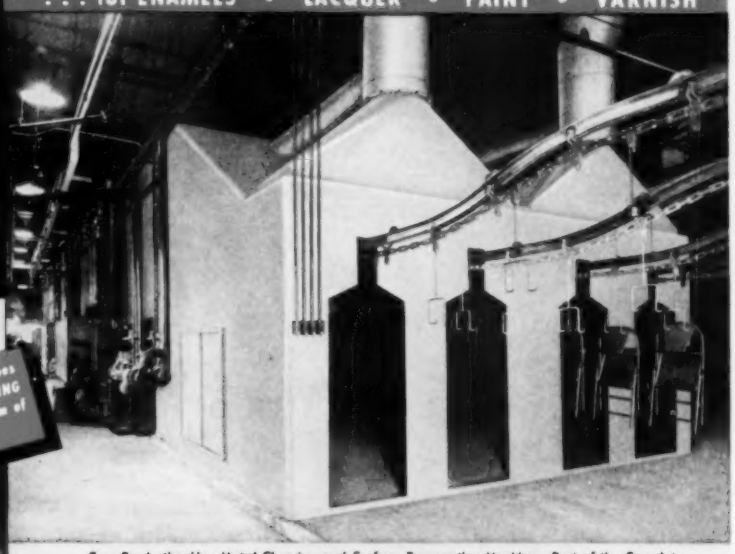
Circle 680 on Inquiry Card

COMPLETE *Finishing* SYSTEMS

. . . for ENAMELS • LACQUER • PAINT • VARNISH

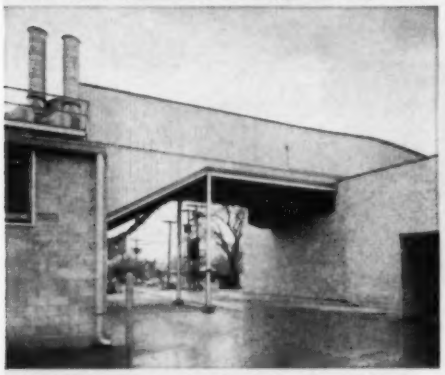


One of the Eight Mahon Ventilated, Circular Electro-Spray Enclosures Employed in the Four Separate Painting Facilities in this System. Note Provisions for Control of Air Movement.



Four-Production-Line Metal Cleaning and Surface Preparation Machine—Part of the Complete Mahon Finishing System in the Durham Manufacturing Corporation's Plant, Muncie, Indiana.

One of the Four Separate Painting Units in this System. Each of the Four Production Lines Passes through an Identical Arrangement —Two Electro-Spray Enclosures and Staggered Touch-up Booth.



Ramp-Tunnel to Finish Baking Oven on Roof. Both Ramp and Oven Accommodate Four Parallel Conveyor Lines in One Straight-through Pass. Equipment is Divided with Two Lines on Each Side. Either Side can be Operated Independently.

Complete NEW FINISHING SYSTEM Provides FLEXIBILITY and Greatly Increased PEAK PRODUCTION CAPACITY!

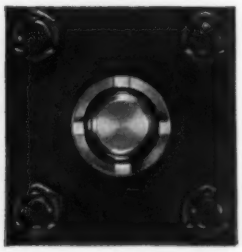
A new and highly efficient Mahon Finishing System at Durham Manufacturing Corporation, Muncie, Indiana, gives management needed flexibility and greatly increased maximum painting production capacity. Four parallel painting production lines pass through the entire system. The Metal Cleaning and Surface Preparation Equipment, Dry-Off Oven, Cooling Tunnel and Finish Baking Oven are designed to accommodate four parallel conveyor lines. Each of the four conveyor production lines passes through one of four separate painting equipment arrangements—each of which includes two circular electro-spray enclosures and a staggered, touch-up Spray Booth. The entire System is designed so that two of the painting production lines can be shut down—the processing equipment is divided for this purpose. An ultramodern Finishing System of this type provides a manufacturer like Durham with painting equipment which will meet peak production demands and still permit operation at 50% capacity with the same efficiency and economy. If you are contemplating new finishing equipment, you, too, will want to discuss methods, equipment requirements and possible production layouts with Mahon engineers . . . you'll find them better qualified to advise you, and better qualified to do the all-important planning, engineering and coordinating of equipment. See Sweet's Plant Engineering File for information, or write for Catalogue A-657.

THE R. C. MAHON COMPANY • Detroit 34, Michigan

SALES-ENGINEERING OFFICES in DETROIT, NEW YORK and CHICAGO

Engineers and Manufacturers of Complete Finishing Systems—including Metal Cleaning, Pickling and Rust Proofing Equipment, Hydro-Filter Spray Booths, Dip and Flow Coaters, Filtered Air Supply Systems, Drying and Baking Ovens, Cooling Tunnels, Heat Treating and Quenching Equipment for Aluminum and Magnesium, and other Units of Special Production Equipment.

MAHON



Here are the world's finest power cylinders

...competitively priced!

This ad is written for the man who has thought all cylinders are "pretty much alike." That just isn't so, and your Hannifin man would like an opportunity to show you why...

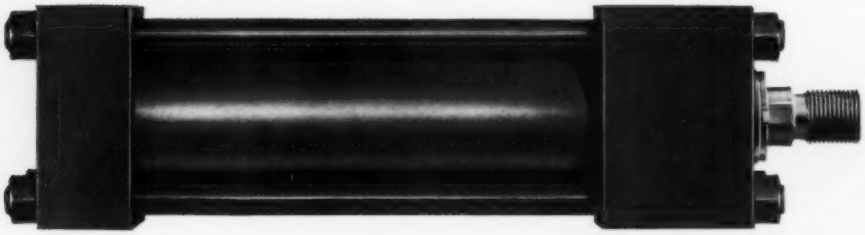
He'll show you design features that other cylinders simply do not have... extra quality workmanship at critical points that pays off in longer life ...accessibility that simplifies their infrequent maintenance. And when he talks price and delivery, you will find these better features cost you no more, can often be delivered sooner.

We think you'll agree that it pays to standardize on Hannifin cylinders.

AIR AND HYDRAULIC

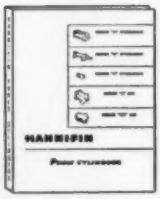
HANNIFIN

POWER CYLINDERS

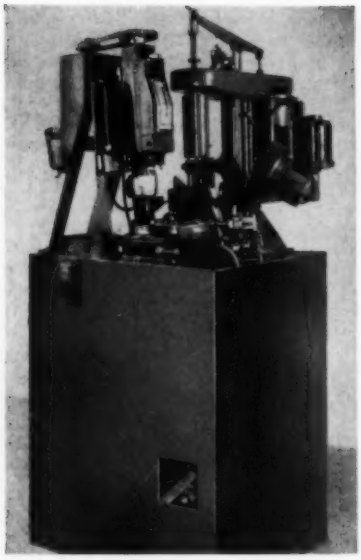


COMPLETE CYLINDER FILE

Write for your copy of this new Hannifin Cylinder File . . . complete, easy-to-use, easy-to-order-from information on five lines of Hannifin Cylinders. Write Hannifin Corporation, 541 S. Wolf Road, Des Plaines, Ill.

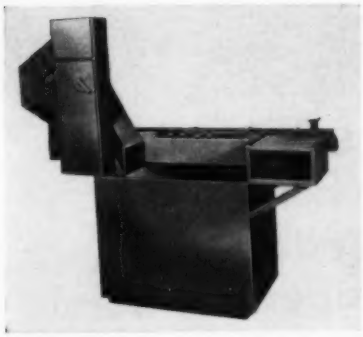


Circle 596 on Inquiry Card



on individual requirements. **Aidlings Inc.**, 1613 E. New York Ave., Brooklyn 12, N. Y.

Circle 412 on Inquiry Card



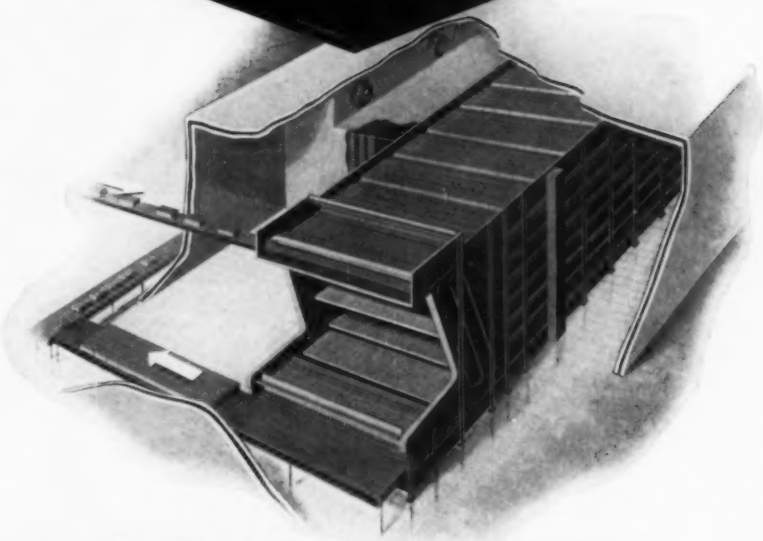
Parts Feeder

Large parts storage capacity and orientation are afforded by automatic parts feeder. The Model 329-PFO unit provides electronically controlled parts flow with a large capacity (8½ cu ft) parts storage bin. The feeder handles a variety of parts in sizes up to 2 inches in diameter, lengths up to 8 inches, and flat parts up to 7 inches in diameter, at speeds up to 20,000 parts per hour.

Rate of feed is automatically regulated, assuring parts flow coordination between the feeder and machine. Storage capacities up to 30 cu ft and larger are available. **Arlin Products Inc.**, 13543 Auburn Ave., Detroit 23, Mich.

Circle 413 on Inquiry Card

Do You Have a HEATING, COOLING or DRYING Problem In Your Production Line?



A **GREER** CONTINUOUS PRODUCTION MULTI-TIER May Solve It

Here's What the MULTI-TIER Can Do For YOU . . .

- Eliminate batch processing.
- Take the human element — and human error — out of your production schedule.
- Improve the quality and uniformity of your product.
- Cut labor costs and headaches.
- Save space.
- Add a "new dimension" to your processing. The Multi-Tier can be engineered to your production requirements and building facilities.

For detailed information, write to

J. W. GREER COMPANY

WILMINGTON, MASSACHUSETTS

GREER

Sales Engineering Offices: Chicago, Ill., San Francisco, Calif.

Circle 597 on Inquiry Card

MICRO SWITCH Precision

...FIRST IN PRECISION SWITCHING

Over 200 MICRO SWITCH Precision Switches help make Lockheed's C-130 Hercules a superb military plane

Wide variety of switch types in the Hercules

Series VA Enclosed Switches
These combine the features of sealed construction and high electrical capacity. They are available with roller arm or lever actuators.

Series V3 Basic Switches
These have the highest electrical capacity for their size of any switch available. Are available in wide variety of terminal designs, contact arrangements and operating characteristics.

Series SE Sealed Subminiature Switches
These are the smallest and lightest completely environment-free precision switches available. They are built to give trouble-free operation in a temperature range of from —65°F to +212°F.

Series DT Double-Pole Double-Throw Switches
These switches simultaneously make and break two independent circuits. The double-pole double-throw switches are rated for 10 amps. 125 or 250 v ac; ½ amp. 125 v dc; ¼ amp. 250 v dc. Temperature rise limits maximum continuous current to 10 amperes per pole.

MICRO SWITCH Engineering Service cooperated with Lockheed engineers of the Georgia Division, Marietta, Ga., for five years in the designing, planning and manufacturing of this plane—the first propjet transport accepted by the U. S. Air Force.

Over 200 precision switches at strategic points perform important functions in the operation of this superb aircraft. Other MICRO SWITCH precision switches are employed in components for this plane supplied by other manufacturers. Still others provide important controls for the machine tools used in the building of the C-130 itself.

Whatever your design—be it aircraft, machine tools, or any type of industrial equipment—MICRO SWITCH components and MICRO SWITCH Engineering Service may help you make a good design even better.

MICRO SWITCH reputation for reliability, precision and performance is written in the success of such products as the Lockheed Hercules and thousands of fine industrial products. MICRO SWITCH Engineering Service is as close as your telephone. Why not call the nearest branch office today?

Switches have uses unlimited

Here's a tough switch to take the roughest going

The MICRO SWITCH sealed Type EN switch was designed to meet tough aircraft problems. Its many unusual features are now meeting many exacting industrial design requirements.

How good is this switch? Check your requirements against tests like these:

- Precise performance at minus 65°F or heated to plus 180°F. (Operating force to 20 lbs. available to facilitate ice breaking.)
- Precise performance after 100 hours in salt brine spray.
- Precise performance after hours of immersion under 36 in. head of alternating iced and heated water.
- Precise performance unaffected by 30 days' operation at 104°F and 95% humidity.
- No chattering of contacts—or loosening of parts—during vibration tests of 10 to 500 cycles per second.

(Send for Catalog No. 77)

Hermetically sealed basic switch insures constant performance

This small MICRO SWITCH Type HS precision switch is truly hermetically sealed (glass to metal and metal to metal) to insure constant operating characteristics under any environmental conditions—for example, no condensation problem.

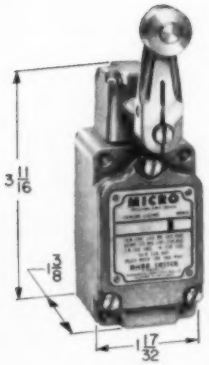
The switch shown has a lever type actuator for inline motion operation. The switch is also available with a roller-lever actuator suitable for actuation by cams, slides or other mechanical means.

Characteristics of Switch Shown

Operating force—10 to 22 oz.; Release force—4 oz. min.; Overtravel—.010 min.; Differential travel—.020 in. max.; Weight—1.5 oz.

Electrical Characteristics—28 volts dc—inductive 10 amperes; resistive 25 amperes; 125 volts ac—inductive 1 ampere; resistive 1 ampere. (Send for Catalog No. 77)

Sealed—Reliable—Versatile—Give millions of operations



The MICRO SWITCH Type LS is a small two-circuit switch which meets a wide variety of industrial design requirements. It is extremely reliable, ruggedly housed and can be mounted in almost any location. Actuator head may be removed in the field and rotated to permit actuation from any of the four quadrants. The roller-arm actuator is field adjustable through 360°. It may operate in either direction, or one direction only.

The electrical rating is: 10 amperes 120, 240 or 480 volts ac; ½ H.P. 120 volts ac; 1 H.P. 240 volts ac; .8 ampere 115 volts dc; .4 ampere 230 volts dc; .1 ampere 550 volts dc. Pilot duty rating is 600 volts ac maximum.

(Complete information in Catalog 83)

MICRO SWITCH, a Division of Honeywell, pioneered the manufacture and development of precision snap-action switches

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

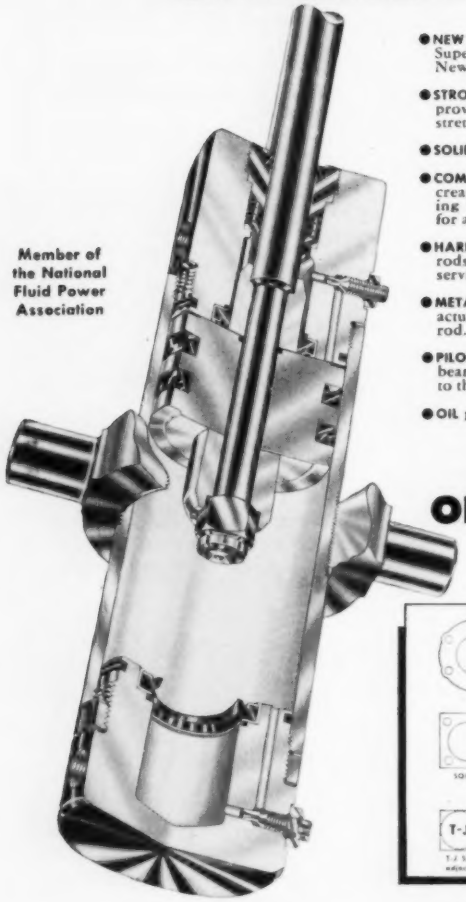
In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS

Circle 598 on Inquiry Card

all the EXTRAS are standard with

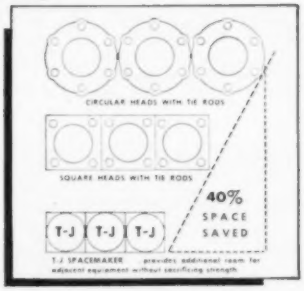
T-J Spacemaker CYLINDERS

Member of the National Fluid Power Association



- **NEW** *exclusive* ingenious cushion designs . . . Super Cushion Flexible Seals for Air . . . New Self-Aligning Master Cushion for Oil.
- **STRONGER** than outmoded tie rod design, proven through actual tests. No tie rods to stretch.
- **SOLID STEEL HEADS** throughout the full line.
- **COMPACT DESIGN** eliminates tie rods, increasing the strength and reducing mounting space required, providing extra room for adjacent equipment.
- **HARD CHROME PLATED** body bores and piston rods . . . assure you of long trouble-free service. (Standard at no extra cost.)
- **METALLIC ROD SCRAPER**, not just a wiper, actually removes foreign matter from the rod.
- **PILOTED PACKING GLAND** with extra long bearing. Additional strength and support to the piston rod.
- **OIL** pressure to 750 p.s.i. AIR to 200 p.s.i.

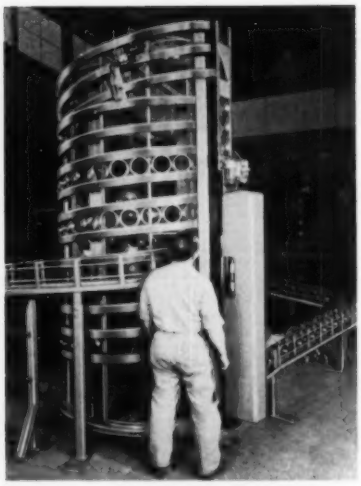
DELIVERY OFF THE SHELF!



You *save 40% space* when you switch from outmoded tie rod cylinders to the T-J Spacemaker! It's stronger, too! Fits right into automation programs in countless plants. Delivers top performance and dependability with a big *plus* in advanced features. Wide range of styles, capacities . . . reduces man-hours and costs in all kinds of push-pull-lift jobs. Off-shelf delivery in 64,000 combinations!

NEW LITERATURE—Send today for new Catalog SM56 with complete engineering details on Spacemaker line. Write The Tomkins-Johnson Co., Jackson, Mich.

T-J TOMKINS-JOHNSON
RIVETORS . . . AIR AND HYDRAULIC CYLINDERS . CUTTERS . CLINCHERS



Rotary Storage Unit

Developed for use in automated processing lines, high capacity storage unit handles parts or blanks that can roll. The unit is designed to offer a true demand-feeding system from a controlled mobile storage medium.

In operation, the parts are guided through a silhouette accept-reject device to fully caged double tracks, and gravity fed to the elevator. The parts elevator is a push type, working off a stroke-lift pneumatic piston. Lifting speed of the elevator is variable through a closed circuit hydraulic cylinder coupled to the air cylinder. The double-shaft elevator and the double-track storage unit not only increase capacity but also facilitate double entry and exit to or from separate points. Either elevator shaft can be operated independently of the other.

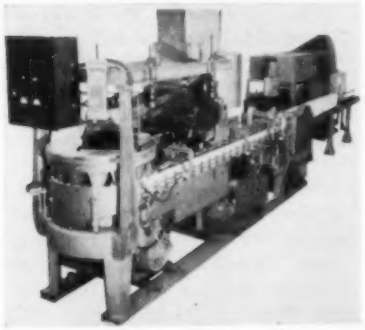
As the parts leave the elevator at the top of the equipment, they are gravity rolled through the circular tracks to the exit chute take-off. The parts can be positioned vertically or horizontally for the following machine operation. Air cylinder operated gates in the tracks control movement of the parts on demand. When used for stockpiling of parts, the equipment automatically stops when full capacity has been reached. This is accomplished by using the static weight of parts to mechanically move air valves which cause the gates to open or close. **Gear-O-Mation Div., Michigan Tool Co.,**

7173 E. McNichols Rd., Detroit 12, Mich.

Circle 414 on Inquiry Card

Packaging Machine

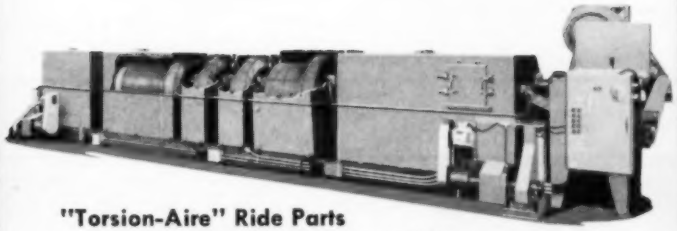
Designed for high speed, automatic and continuous operation, Model EH Neverstop machine is well suited for packaging free flowing products such as cereals, spices, chemicals, etc., in carton sizes from 2¾ by ¾ by 3⅜ inches up to 4 by 2⅛ by 5¼ inches. No inner liner is required in achieving a sift-proof, air-tight seal. The cartons are preheated just prior to the application of a hot-melt adhesive for the bottom seal. After filling, the hot-melt adhesive is applied for the top seal and the carton enters a turn-around section on the conveyor preparatory to final drying. At this point, the adhesive on the side flaps of the carton is reactivated, and the flaps are sealed under pressure. The carton passes through a refrigeration unit to set the adhesive quickly as it travels through the short drying conveyor.



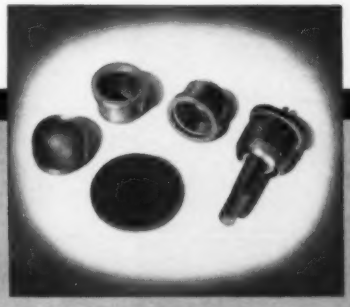
The filling action utilizes a vibratory feed mechanism, electronically controlled to assure filling accuracy, which permits speeds in excess of 350 cartons per minute. As the product to be packaged moves down a vibrator trough to the cartons, it is automatically checked for weight on a scale pan. If product density or rate of flow varies from a preset weight, electronic controls automatically adjust the intensity of vibration of the trough to restore the rate of flow to its preset level. **Stokes & Smith Co.**, 4992 Summerdale Ave., Philadelphia 24, Pa.

Circle 415 on Inquiry Card

CHRYSLER REDUCES COSTS ON MANY PARTS WITH DETREX EQUIPMENT



"Torsion-Aire" Ride Parts Prepared for Cold Extrusion with DETREX Processing Unit



Automatic Rotary Transfer Continuous Multi-Stage Processing Unit Installed at Chrysler Corporation, New Castle, plant.

Steps in cold forming of Safety-Sphere ball joint assembly for "Torsion-Aire" front end assembly.

The Chrysler Corporation, New Castle, Indiana plant, has developed a highly efficient cold extrusion operation for forming Safety-Sphere joints used in the "Torsion-Aire" suspension system of all Chrysler-built cars. Blanks, as well as intermediate formed parts, are *automatically* fed through a specially designed DETREX processing unit which cleans, rinses, pickles, hot-rinses, cold-rinses, phosphate coats, rinses, lubricates and dries—*all in one operation!*

Such installations have brought savings of up to 40% to some operations. Final machining is greatly reduced or eliminated. More savings are effected through use of low-carbon steel. Finished parts are stronger, smoother. Many shapes previously impossible to cold form are practical with DETREX methods and equipment.

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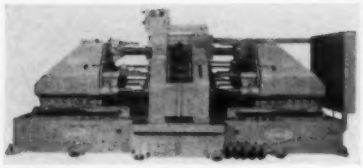

Core Driller & Reamer

Up to 52 forged steering knuckles are processed per hour at 100 per cent efficiency by five-station trunnion type machine. The unit performs core drilling and reaming with a completely automatic cycle. Full reduction heads are specially built, with 15-hp bevel gear drive, mounted on the Baker basic model 1830 standard slides. The basic slide units are flexible automation units that can be used in combination as a transfer machine, or separately. Twin-pull cylinders for feed are located on the outside of the slide, easily accessible for service. **Baker Bros. Inc.**, Toledo 10, O.

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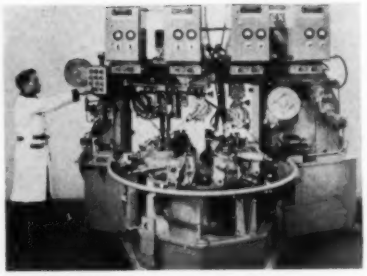

Arc Welder

Automated eight-station horizontal rotary index arc welding machine is designed for accurately positioning and welding together two-piece production parts. Two-stage clamping fixtures are located at each table station. One fixture stage accurately positions and clamps a two-piece part while tack welding operations are performed. The second stage fixture clamps and rotates the tack welded assembly while continuous contour welds are made on both sides of the part. The index table is driven by a standard cam index mechanism which provides smooth index movement and simplifies overall machine design.

Illustrated model welds (by the CO_2 shielded arc method) a plate to a bushing to produce 320 automotive anchor plate assemblies per hour at 80 per cent efficiency. By changing the clamping fixtures, the machine can be adapted to a variety of two-piece parts which require accurate positioning and joining with continuous contour welds. Machine is also adaptable to argon shielded arc welding. **Expert Welding Machine Co.**, 17144 Mt. Elliott Ave., Detroit 12, Mich.

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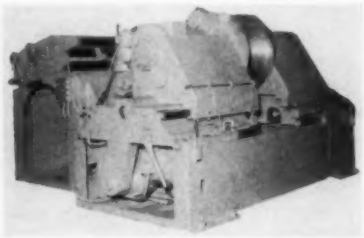
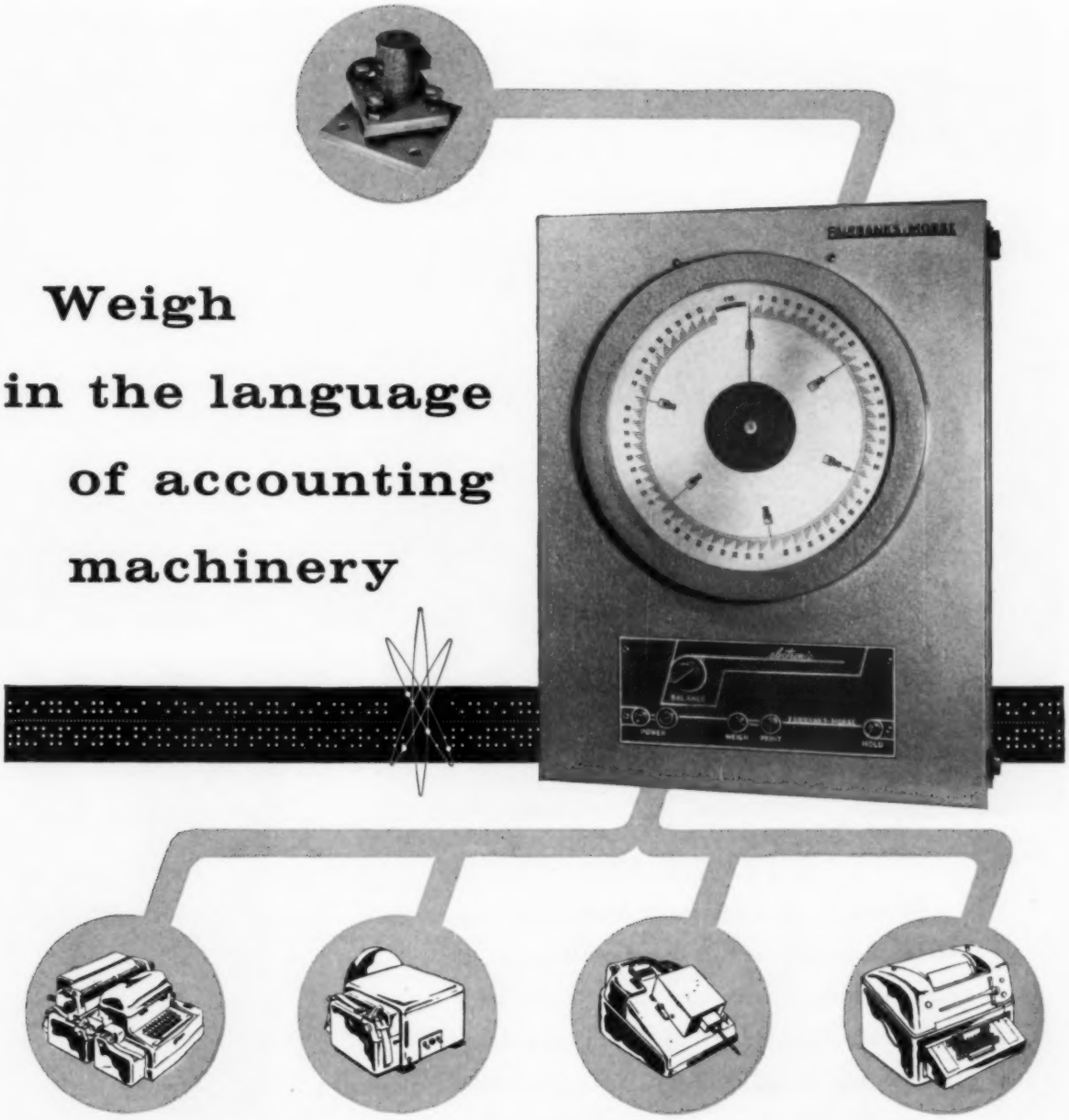


Cradle & Straightener

Designed to handle coils from 10 to 60 inches wide by 66 inches maximum OD, cone type cradle and



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The weight message from the electronic load cell is translated to the language of business machines by the Fairbanks-Morse Model CDO Readout Instrument. The CDO will convert from decimal to the five channel, seven channel, eight channel or coded decimal codes—whichever system you are using. Send for the new CDO bulletin No. ED-16 today. It will suggest many applications for automatic and remote weighing. Fairbanks, Morse & Co., Dept. A-5, 600 South Michigan Ave., Chicago 5, Illinois.

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straightener unit is arranged with a cylinder for roll loading and a lift cylinder to center coils with the cones. To eliminate any excessive overhang of cone support body gibbing, a second slide is set at 4 inches more than the coil width which is to be handled, thereby allowing roll loading regardless of coil width. Lateral travel of cones is motorized and actuated by a screw.

The straightener on the machine has five rolls and two sets of pinch rolls. All pinch and lower straightener rolls are driven; the upper straightener rolls are adjustable individually or together; there is a hand release on the pinch rolls. Motorized threading is included in the machine. The cradles are available to handle from 20,000 to 50,000 lb coils. **Automatic Feed Co.**, P.O. Box 391, Napoleon, O.

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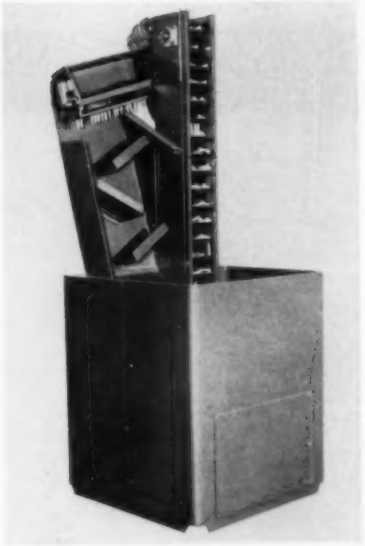
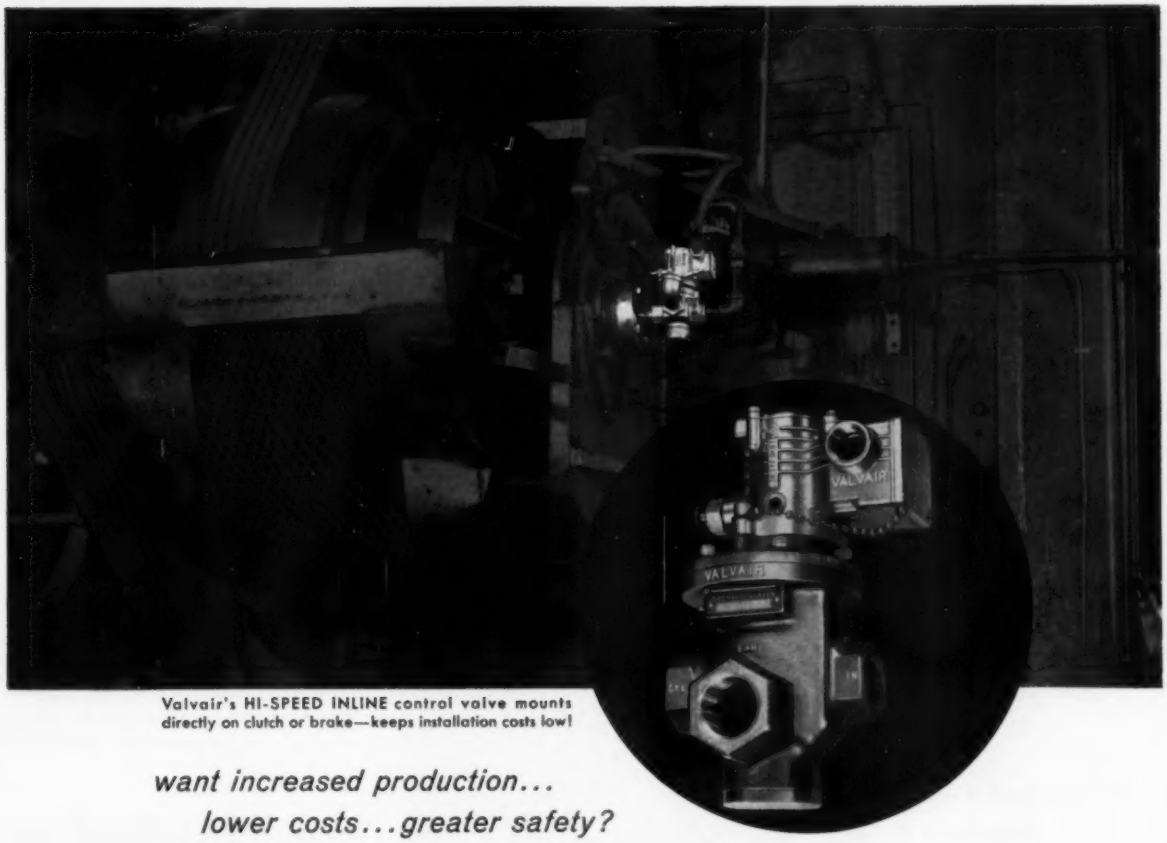


Elevating Hopper

Sliding, rolling or headed parts are fed automatically into production machines at predetermined speeds by Model # 2000 elevating hopper. In-process workpieces are picked up from a storage hopper by a cleated steel belt conveyor and elevated to an adjustable roll orienting mechanism. Oriented parts then are fed into a work chute to the production machine. Parts not properly



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Valvair HI-SPEED INLINES *are available for immediate delivery from stock*, in sizes and types for every need. Specify them on new equipment . . . use them to replace obsolete valves now in service . . . one installation will convince you! Valvair Corporation, 454 Morgan Ave., Akron 11, Ohio.

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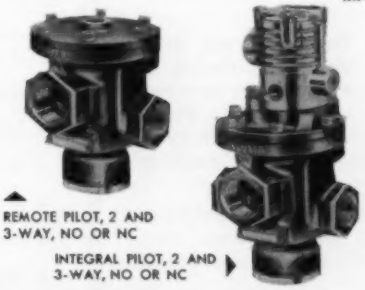

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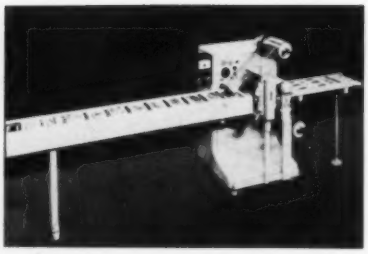
Circle 604 on Inquiry Card

oriented are routed back into the hopper by rubber lined baffles. The rate of feed is controlled by the variable speed conveyor.

Electrically controlled, each feeder is completely self-contained and has variable speed transmission motor and a 6-cu ft storage hopper with a 36-inch loading height. The unit requires minimum tooling changes to accommodate different parts. **Production Feeder Corp.**, 3130 Johnnycake Ridge Rd., Mentor O.

Circle 419 on Inquiry Card



Packaging Machines

Available in three models, two of which feed horizontally and one which feeds vertically, Flexopaker line of flexible packaging machines offers quick adjustability at speeds ranging from 40 to 100 packages per minute. Each of the three models is available in two sizes and includes adjustable sealing rings, a cut-off mechanism, thermostatic heat controls and a variable speed drive which comes in two speed ranges.

The vertical feed model is used in the handling of such products as screws, nuts, bolts, nails, powders, free-flowing articles, pastes and liquids. For wrapping papers other than cellophane, proportional type heat controls are available. Typical applications of the horizontal feed units are bakery products, textiles, hardware, paper products and automotive parts.

The package size can be adjusted on all three models from a minimum size of 1½ inches by 1½ inches by 1/16-inch to a maximum of 27 inches by 15 inches by 2 inches. **Battle Creek Packaging Machines Inc.**, Battle Creek, Mich.

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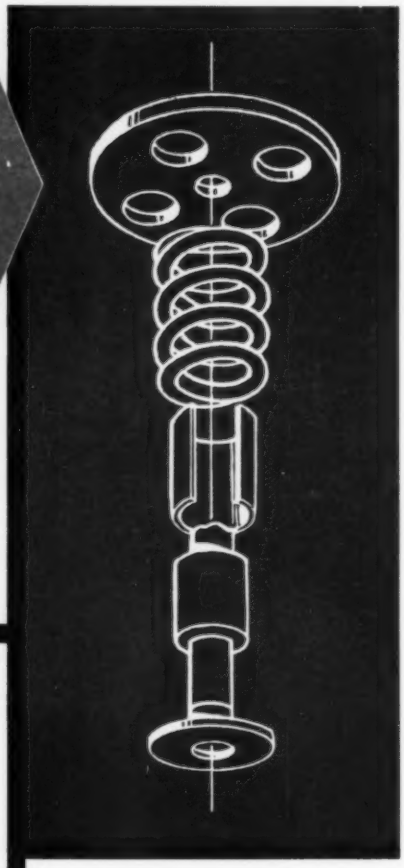
GRAY Automated EQUIPMENT Gives Six Times Faster Assembly Per Worker



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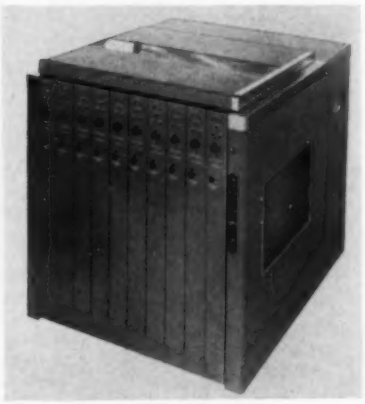

Tape Handler

Digital magnetic tape multiple bin handler, Model 3219, stores over 160 million bits and can be employed for sequential sorting or as a random access memory of high capacity. The tape handler consists of ten separate identical units or bins, each with a storage capacity of over 8 million bits; a bin normally contains 500 ft of 1-inch magnetic recording tape for 14-channel recording with 200 pulses per inch density. Each bin is equipped with its own

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Automation has an opening for an engineer with manufacturing-production-equipment background and ability to write. Age 25-30.

Headquarters are in Cleveland, but there will be opportunity to travel on editorial assignments and attend meetings, expositions, etc.

This is a real challenge for a man with enthusiasm for writing and a strong creative urge to broaden his perspective and assist industry in effectively applying the techniques of automation.

Please send particulars to the Editor, AUTOMATION, Penton Building, Cleveland 13, Ohio.

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record-playback head which may be relay switched to a common output.

Employing the digit-by-digit method with a simple counter and matrix, decimal sorting rates up to 100 information blocks per second are achieved. Used in conjunction with a supplemental tape device, alphanumerical information can be sorted and recorded in the proper bins, and then reassembled in sequential order. The device may also be used as a random access memory requiring less than a minute for access to any of more than 22 million possible stored alphanumerical characters. The tape handler is used with high speed computers, printers, industrial control equipment and electronic data processing systems. **Potter Instrument Co.**, 115 Cutter Mill Rd., Great Neck, L. I., N. Y.

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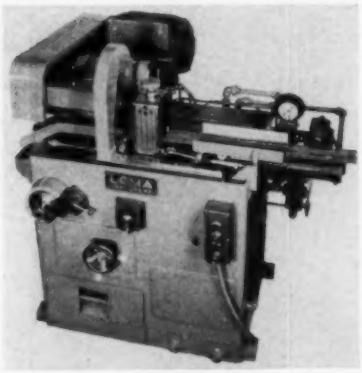

Cut-Off Saw

Designed for the automatic cutting-to-length of nonferrous tubes and rods, high production circular cut-off saw handles a range of sizes from less than ¼-inch to 4 inches in diameter. A feature of the saw is its swinging arm design, which causes an oscillating movement of the sawblade. The resulting cutting action greatly facilitates multiple strand sawing, and as many as ten tubes or rods can be cut simultaneously on the machine.

The up and down movement of the saw arm is effected by a combination oil-air system of cylinders. Another feature of the machine is the double stock clamp which

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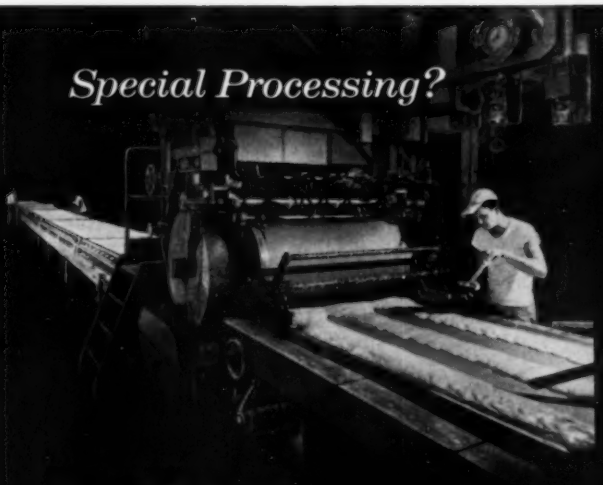
Special Processing?



Looking for the Answer to a Tough Production Problem...

Materials Handling?

Frequently, the design of special machines will provide the answer. Helping management resolve production problems through the application of automated equipment is one of the important services offered by the Giffels & Vallet organization. This machine design service reflects years of extensive experience gained through the planning and engineering of production facilities for companies of widely diversified activity, in every area of industry. These practical insights have proved of great value in analyzing and applying solutions to problems involving special machines, mechanization, and automation.

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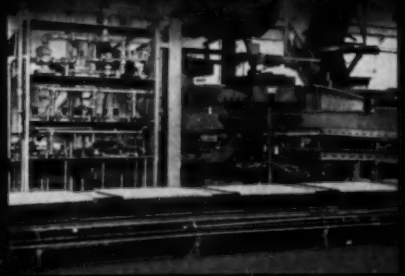
Fabrication?

G&V services are discussed in a special Planning Brochure. A copy will be mailed on request.

Assembly?



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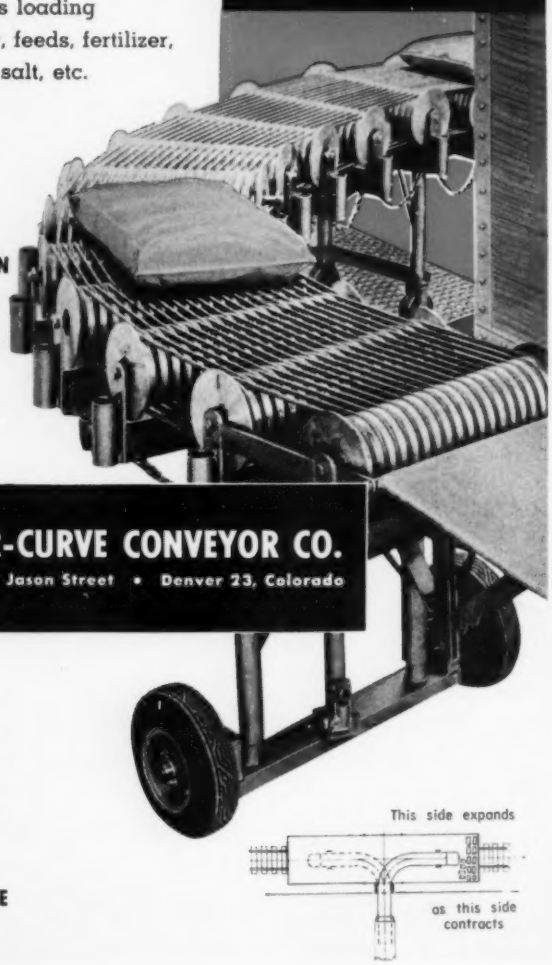

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contributes to the saw cuts being practically free of burr. The entire sawing cycle—stock advance, clamping, saw feed, saw return, clamp release and stock discharge—is automatically controlled and interlocked. A single pushbutton starts the cycle. The advance of stock along the feed-in table is obtained by a motor driven belt conveyor. Adjustable lateral guides keep the stock in a straight line, perpendicular to the sawblade. The saw cuts off lengths up to 12 inches; sawblade operates at a peripheral speed of approximately 10,000 fpm. **Loma Machine Mfg. Co. Inc.,** 114 E. 32nd St., New York 16, N. Y.

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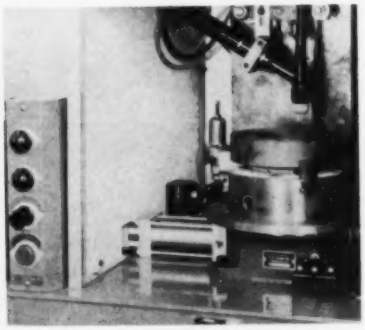

Automatic Welder

Comprising a standard dc welding machine and separate all-metal enclosure which houses the torch, indexing table, automatic and regulatory controls, automatic welding machine features the following advantages: Unskilled operator performs a welding task difficult even for a skilled welder; the welding operation may be viewed by several people simultaneously; fully automatic adjustments, controls and operation; and maximum safety for operators and viewers.

When the door of the welding enclosure is open, a green light glows, indicating that the machine is not in operation and that it is safe to reach inside. The operator may then secure the workpiece on the index table. When the door is closed and the *Start* button is pushed, a red light glows, indicating that the controls are operating automatically, regulating argon gas, water for cooling the torch, welding cur-

rent and movement of torch across the workpiece. Should the door be opened during operation, the machine ceases to operate. Torch height and other operating controls are quickly adjusted to accommodate a variety of workpieces of different diameters and thicknesses. **Automatic Methods Inc.**, 875 W. Grand St., Elizabeth, N. J.

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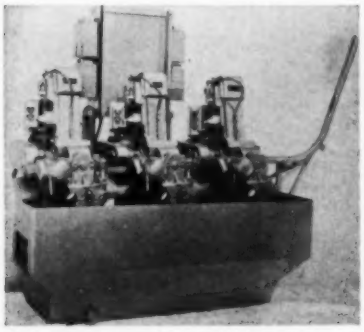

Centerless Belt Grinder

Designed for high speed volume production on ferrous, nonferrous, plastic, glass and other materials, wet-or-dry belt centerless grinder combines three operations in a single automatic cycle. Continuous through-feed feature permits use of a gravity feed hopper for smaller cylindrical parts, which are automatically ejected at the opposite end. Accommodating stock from 3/32 to 2¾ inches in diameter and any length, the Model L4-3 maintains tolerances of 0.001-inch or less, at through feed rates up to 35 fpm.

Typical grinding sequence, using a series of progressively finer grit abrasive belts, is rough grind, finish grind, and fine polish. The machine is also available with four grinding heads where an additional operation such as semifinish is required. Each head is equipped with individual control panels and size control. Through-feed rates are controlled by the adjustable helix angle of the regulating wheel, in combination with change gears which drive the regulating wheels at different rpm. Belt speed is 5000 sfpm and the abrasive belts, 4 by 54 inches, can be changed in less than a minute. **Engelberg Huller Co.**, 831 W. Fayette St., Syracuse 4, N.Y.

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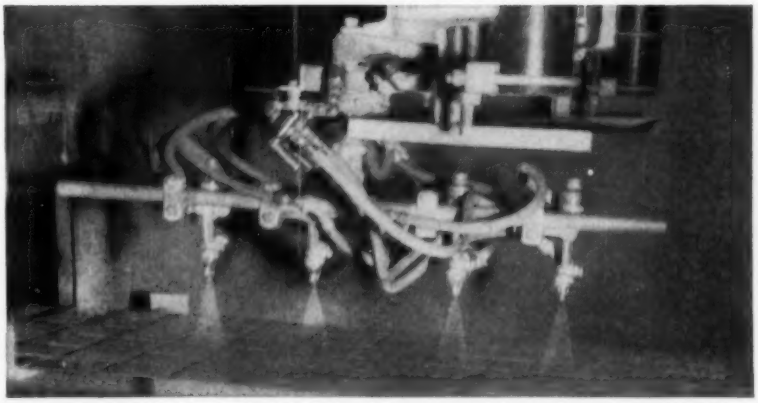

A Binks Automatic Reciprocating Machine and Model 21V automatic spray guns apply porcelain enamel to the face of aluminum wall tile. A similar machine has previously sprayed the reverse side. Special conveyor turns tile over between operations. Tungsten carbide inserts and tips in the spray gun fluid nozzles lengthen their production life.

"At Vikon Tile, we discovered the plus in Binks equipment..."

"We discovered the 'plus' in Binks equipment when we decided to enter a new field of spraying porcelain enamel to aluminum wall tile," reports Mr. Charles J. Jensen, President of The Vikon Tile Corporation, Washington, New Jersey.

"This 'plus' was the finishing experience brought us by the Binks man. It was of immeasurable assistance...in recommending proper equipment...in setting up a pilot operation...in putting our finishing line into high-gear. Today, we automatically spray-apply porcelain enamel to both sides of the tile, fire and package in 15 minutes, from start to finish."

Binks pressure fluid tanks with air-driven agitators supply porcelain enamel to two Binks automatic spray machines. Stainless steel inner tank containers and shut-off cocks prevent parts corrosion and fluid contamination.

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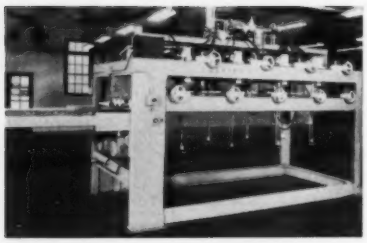
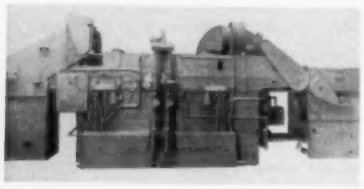


Sheet Steel Feeder

Developed for feeding heavy gage sheet steel to such processing equipment as punch presses, shot blasters, roll formers, slitters, trimmers, etc., machine handles sheet approximately ⅛-inch thick. Feeders may be constructed for sheets of any reasonable size; illustrated model handles sheets 42 inches wide by 120 inches long.

In operation, stacks of sheet are brought to the feeder and deposited on its loading platform by fork truck. Vacuum cups then reach down, grip the top sheet and lift it as much as 18 inches to permanent magnets which hold the sheet in standby position. The processing equipment being fed triggers the feeder when it is ready, and a pusher shoves the sheet forward into feed rollers which deliver it to a short conveyor section leading directly to the processing machine. When the sheet passes a predetermined point in the production operation, the suction cups of the feeder reach down and lift the next sheet into standby position. **Dexter Folder Co.**, 219 E. 44th St., New York, N.Y.

Circle 425 on Inquiry Card



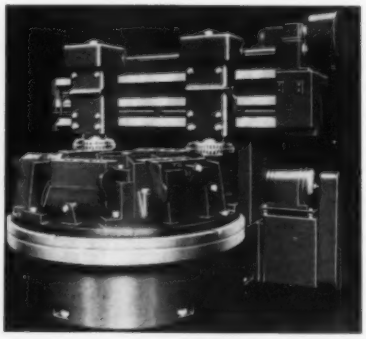
Cleaning Machine

Designed and installed for a nut and bolt manufacturing plant, automatic work and tote pan cleaning machine is adaptable for any parts handled in tote pans, boxes and similar containers. The machine was built for a wash, rinse and dry sequence, but can incorporate any combination of cleaning, pickling, and phosphate coating operations.

The machine receives tote pans of work, dumps the work into a drum type washing section, then carries the inverted tote pan through an integral conveyor type washing section above the drum section where work is processed. Both work and tote pans are washed, rinsed and dried. Tote pans return to the discharge end of the machine ahead of the parts they formerly contained. The clean, dry batch of work is then reloaded automatically into the clean and dry tote pan.

A single pump and motor recirculates solution to both drum and conveyor section at each stage. **Ransohoff Inc.**, N. Fifth St. & Ford Blvd., Hamilton, O.

Circle 426 on Inquiry Card

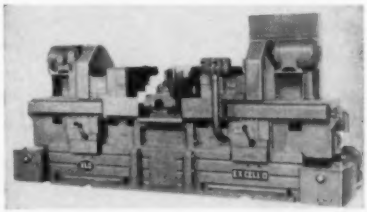


Rotary Milling Machine

Work can be held and released automatically, and fed continuously in multiple setups to the milling cutters of vertical rotary milling machine developed for the automotive and aircraft industries. Compact and comparatively small, the unit is in line with the trend toward higher productivity.

Of box-type construction with columns and cross rail cast integral and bolted to the bed for rigid application of the cutters to the work, the machine permits accurate milling. Fixture arrangement allows flexible setups. Finished work can be taken off the table and the new work put on while the table is moving and the cutters are operating. The spindle heads are independently adjustable vertically and horizontally, enabling the operator in one pass to rough cut with one cutter, and at the same time, finish with the second, or to rough or finish on two levels in two different cutting circles. The 72-inch diameter table can be set for speeds up to 100 inches per hour. **Machine Tool Dept., Box 153, Hamilton Div., Baldwin - Lima - Hamilton Corp.**, Hamilton, O.

Circle 427 on Inquiry Card



Precision Borer

Production of yokes for automotive universal joints is increased by the installation of a two-way boring machine. The precision unit maintains a fast production schedule by permitting simultaneous operations at both ends of the part.

Made of malleable iron, the universal joint yokes are clamped in a fixture and two holes are finish bored in line. The three-station, hydraulically operated fixture and three boring spindles on each slide of the machine produce three machined yokes in each automatic cycle. The machines are applicable to workpieces of many different sizes, weights, shapes and machining requirements. **Ex-Cell-O Corp.**, 1200 Oakman Blvd., Detroit 32, Mich.

Circle 428 on Inquiry Card

Wire Cutter & Stripper

Developed with features to meet the needs of the electronics industry, wire cutting and stripping machine is designed to cut single conductor, solid or stranded wire of 32 to 12 gage into lengths from 1 to 300 inches and to remove the insulation from one or both ends without scraping or cutting strands. The strip lengths may be varied from ⅛ to 1 inch.

The Model 810 machine is economical for short run as well as long run production. Wire travels

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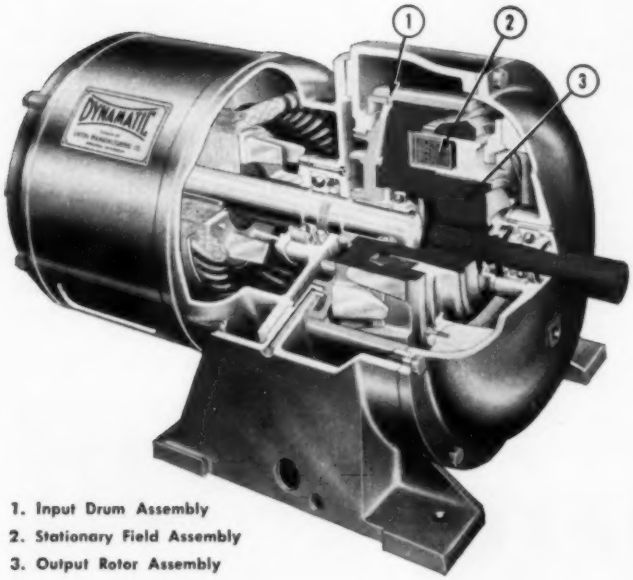
DYNASPEDE® ADJUSTABLE SPEED DRIVES

Provide these important Advantages



1. Input Drum Assembly
2. Stationary Field Assembly
3. Output Rotor Assembly

1. Adjustable speed from AC power source
2. Accurate speed control
3. Wide speed range
4. Rapid response
5. Low power losses
6. No commutators, rings, brushes, or rotating coils
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10. Low maintenance cost

For a long list of industrial drive applications where stepless adjustable speed is required, the new Dynamatic Dynaspede® Drives are ideal. The liquid-cooled, completely enclosed, stationary field eddy-current couplings are available mounted integrally with D-flange squirrel cage motors in capacities from 3 to 75 HP. Motor types available are drip-proof, totally enclosed fan-cooled, and explosion-proof.

Separately mounted couplings in capacities from 3 to 2500 HP, and larger, are also available. Dynamatic electronic or magnetic amplifier controls, in combination with these drives, provide wide latitude in operating functions.

Send for Illustrated Literature Describing These New Stationary Field Drives and Couplings

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Look to NORTH

Designed to meet MIL-R-5757C, the NORTH IR-226 is being widely used in many airborne applications that require a vibration-proof, shock-resistant, hermetically sealed, sensitive relay.

NORTH IR-226 is being specified as a component in plate circuits for power amplification.

Where low-level switching requirements are highly critical the IR-226 contacts have been tested at 8 micro-amps and 30 milli-volts.

The IR-226 has demonstrated complete reliability at 40 milli-watt sensitivity.

Whether your requirements include relays for production runs or for relay engineering and design for prototype development, NORTH's 72 years of experience in engineering, design, and precision manufacture of relays for commercial and military applications can be applied to meet your demands.

IR-226
Actual Size

INDUSTRIAL DIVISION

NORTH ELECTRIC COMPANY

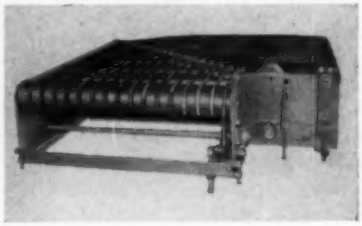
725 SOUTH MARKET STREET • GALION, OHIO

Available in Canada through Ericsson Telephone Sales of Canada, Ltd., Montreal 8, P. Q.

Circle 612 on Inquiry Card

through the machine at speeds up to 150 fpm. Production rates at top speed range from approximately 350 pieces (300-inch size) per hour to more than 8000 pieces (1-inch size) per hour. The machine, controlled from a central panel, uses both electric and pneumatic power. The feed rolls are motor driven and pneumatically controlled. Pneumatic power is also used to operate the cutting and stripping mechanism and to eject the finished wires. **Eubanks Engineering Co.**, 260 N. Allen Ave., Pasadena, Calif.

Circle 429 on Inquiry Card



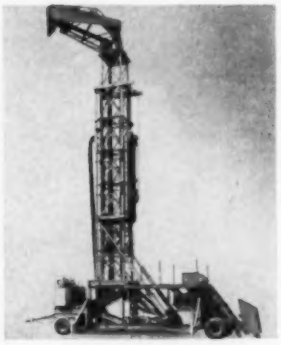
Conveyor Turns

Designed to solve the problem of 90-degree turns in conveyor and material handling systems, device has no rollers to stick, tight corners to jam or deflectors to damage the products being moved. Operation of the conveyor turn is based on a series of narrow belts running in grooved pulleys, meeting to provide an angular direction of flow. The belts are banked for constant contact with the material in motion, and positive belt guides prevent side shear as the material changes direction. A slight differential in speed between the bank of belts produces a positive turning action. Friction reaction to turning is eliminated by the design of the belts and their mount-

ings. Belts are spaced to carry small as well as large or long articles, while giving ample support to flexible products.

With the device, conveyor systems can go around any degree of corner turn required, up to 90 degrees. Parallel conveyor lines can be mounted side by side without the need of radius turns, and converging conveyors can be fed into a single conveyor. **Stewart-Glapat Corp.**, 1639 Moxahala Ave., Zanesville, O.

Circle 430 on Inquiry Card



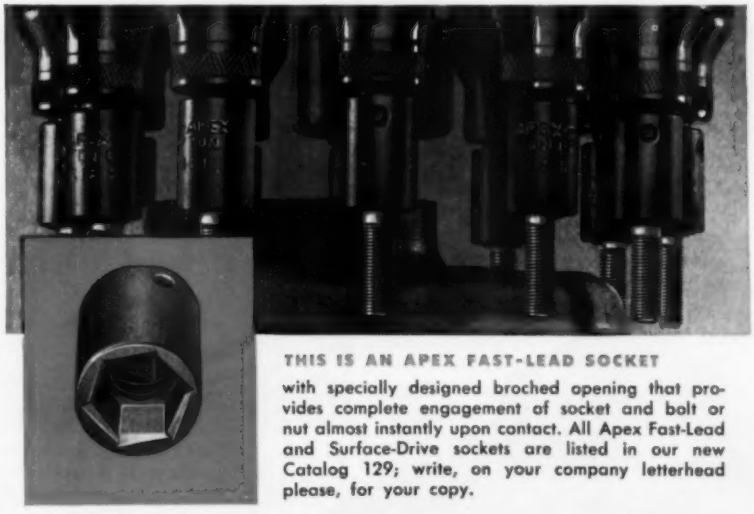
Catalyst Loader

Adjustable from 45 to 70 ft in 5-ft increments, loading elevator delivers catalyst at a rate of 15 to 30 tons per hour, depending on density, without manual handling. The unit, which has been dubbed the Dinosaur, has a telescoping boom which can be extended when in vertical position to the full height of 70 ft. The boom can be stowed in a horizontal position, and the entire unit moved easily and conveniently from station to station.

Catalyst is handled by a zipper conveyor belt that automatically opens to receive material which is then carried to the discharge point completely enclosed and protected. Catalyst material is fed by means of a barrel dumping device to a vibrating screen which may perform a scalping operation. The barrel dumper completes a cycle every 45 seconds for a capacity of 80 barrels per hour. If desired, pallets of bagged material may be lifted by fork truck to the working platform for manual dumping. **Stephens-Adamson Mfg. Co.**, Aurora, Ill.

Circle 431 on Inquiry Card

In less time than you took to look at these two photos, 12 hex head bolts can be run down snugly and another pump unit assembled. This is modern fastening, using NEW multiple-unit power tools and NEW Apex Fast-Lead Sockets, specifically designed for split-second assembly.



THIS IS AN APEX FAST-LEAD SOCKET

with specially designed broched opening that provides complete engagement of socket and bolt or nut almost instantly upon contact. All Apex Fast-Lead and Surface-Drive sockets are listed in our new Catalog 129; write, on your company letterhead please, for your copy.

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Masterpiece of simplicity

Consider the egg. Unique in shape, clean of line, its design is functionally perfect.

Much the same can be said of a MAC valve. Trim and compact, its simplified design meets the severe demands of our toughest customer. We engineered it to deliver the speed and stamina required by resistance-welding equipment . . . and knew this basic design would pay off handsomely in performance on less exacting jobs, too. That's why *all* MAC valves are built to these same rugged design specifications.

And that's why you can expect *more* from MAC—in efficiency and dependability, in longer life. Get proof. Contact a representative listed at right or send for the facts.

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park, Detroit 37, Michigan

MAC

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DENVER 16—Blair Engineering Co., 4100 Grape St., FLorida 5-7142

FLORIDA
MIAMI SPRINGS—Aero Hardware & Supply Co., 4301 Northwest 36th St., TUxedo 8-2414

ILLINOIS
CHICAGO 43—Mike C. Modrich Co., 10918 South Western Ave., HIlltop 5-3640

INDIANA
FORT WAYNE 3—Neff Engineering Co., P.O. Box 2001, Station A, 2339 Crescent Ave., EAstbrook 7391
INDIANAPOLIS 20—Neff Engineering Co., P.O. Box 7361, 42nd St. Station, CLifford 5-5418
SOUTH BEND—Dick Futter, 103 South Varsity Dr., CEntral 2-3800

MASSACHUSETTS (and New England)
BOSTON 34—Electrical Apparatus Co., Inc., 1200 Soldiers Field Rd., STadium 2-7440

MICHIGAN
BAY CITY—Fred Kober, 506 Chilson St., TWinbrook 2-2629
FLINT—Kober Sales Engineering Co., 1115 Root St., CEdar 2-7165
WESTERN MICHIGAN—Everett Adams, 17212 Sharon Road, Chesaning, Michigan, Chesaning 383-J-1

MINNESOTA
MINNEAPOLIS 4—Air Engineering & Supply Co., 2445 Nicollet Ave., FEderal 9-5579
ST. PAUL 14—W. H. Schulz Co., 2438 Franklin Ave., MIdway 4-2791

MISSOURI
ST. LOUIS COUNTY—Oscar E. Jost Co., P. O. Box 6, St. Ann, HArrison 8-4488

NEW YORK
BUFFALO 28—C. H. Tepas Co., 200 Washington Hwy., CIrcle 3210

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CINCINNATI—The R. W. Nichols Co., Fidelity Federal Savings Bldg., 2087-9 Sherman Ave., Norwood, ELmhurst 1-2440
DAYTON—The R. W. Nichols Co., 407 Realty Bldg., MIchigan 4724
OLMSTED FALLS—The R. W. Nichols Co., P. O. Box 6, ADams 5-3366
TOLEDO 4—The R. W. Nichols Co., 510 Manhattan Building, CHerry 1-1447

OREGON
PORTLAND—The Rucker Co., 911 N. W. Hoyt St., CApitol 3-0205

PENNSYLVANIA
PITTSBURGH 22—The R. W. Nichols Co., 101 Investment Bldg., ATlantic 1-6050

TEXAS
DALLAS 19—Womack Machine Supply Co., Shea Rd. at 7150 Harry Hines, FLeetwood 7-3871

WASHINGTON
SEATTLE—The Rucker Co., 1000 4th Ave., South, MAin 2783

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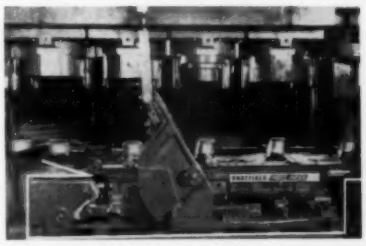
MECHANICAL AIR CONTROLS, INC.
DETROIT 37, MICHIGAN
MAC

Sorting Machine

Based upon a no-drift electronic principle of gaging and a mechanical memory system, Autosorter machine sorts items ranging from bearing balls to gears and piston pins into as many as 13 categories. The machine can be set for increments varying from ten millionths to ten thousandths. Accuracy between classes is guaranteed as low as 0.000002-inch. Speed range averages around 10,000 pieces per hour, depending upon the size and type of the piece.

For changing to different types of workpieces, the top portion containing the mechanical feeding and positioning elements is removed and replaced by means of three cap screws. For visual inspection of balls and rollers, a stroboscopic light is used to indicate out-of-roundness. **EAM Div., Industrial Gauges Corp.**, W. Englewood, N.J.

Circle 432 on Inquiry Card

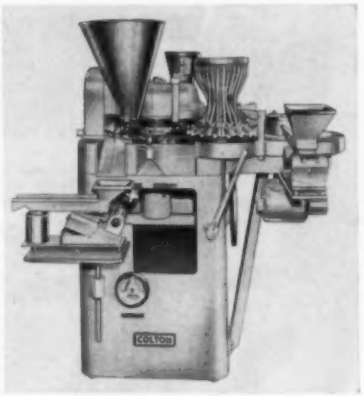


Stamping Transfer Unit

Developed to convert any standard press into an automated unit capable of handling a number of progressive operations and a broad range of sizes, mechanical transfer unit is called the Press Pacer. The device transfers stampings from one die station to the next on each stroke of the ram. It can also be used to transfer parts between presses.

The Press Pacer is mechanical in operation; there are no electrical, pneumatic or hydraulic connections or movements. The unit consists of a pair of transfer rails, one on each side of the press, on which are mounted opposed pickup fingers that transfer parts to the next station on each upstroke of the ram. Transfer motion is obtained by means of a lever bolted to the ram. The pickup fingers are easily changed to accommodate different parts. **Sheffield Corp.**, Dayton 1, 0.

Circle 433 on Inquiry Card



Compression Coater

Used to apply uniform, dry coatings to compressed tablet cores at rates up to 900 tablets per minute, machine is designated the Colton Model 232 compression coater. Powered by a 2 hp motor, the machine applies coatings of dry material to round flat-face or shallow convex-face compressed cores of either friable or hard tablet types. Maximum diameter of the finish coated tablets handled by the standard machine is $\frac{5}{8}$-inch. Total standard depth of fill is $\frac{1}{2}$-inch, and maximum compression force is 5000 lb.

Basically the coating machine is a standard high speed rotary tablet press with one set of pressure rolls removed. A core feeding mechanism replaces the set of rolls. The core feeding mechanism assures that no tablets will be made without cores. The mechanism is so designed that the core is placed firmly in the lower granulation to provide positive centering. Upward

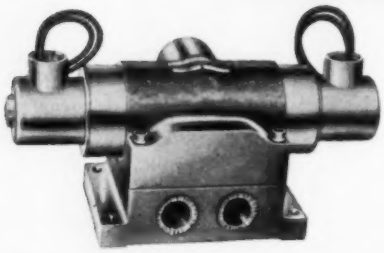
Want to control air or hydraulic circuits electrically?

GET THESE FIVE ADVANTAGES WITH

Modernair Trademark

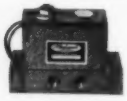
SOLENOID VALVES

for air or hydraulic service to 150 psi



MV SERIES double solenoid for 3 or 4-way operation in ¾" and 1" port sizes is only 13¾" long. Shown with removable sub-base; also available in threaded body, and with single solenoid.

MV SERIES single solenoid in ⅜" and ½" port sizes is only 7⅜" long. Available in same styles as larger MV, at top.



Ultra-compact BV series with ¼" ports is only 4½" long; made in single or double solenoid for 3 or 4-way operation.

1. "O" RING SEALING for extra-long service life, easy replacement without removing valves from line.

2. NON-CORROSIVE CONSTRUCTION throughout — cast aluminum body, brass porting sleeve, aluminum sliding spool.

3. COMPACTNESS... note dimensions, figure the space you'll save!

4. EASY INSTALLATION... MV Series are available in threaded body or removable sub-plate or manifold mountings; BV series has rectangular body with flat surfaces for easy mounting.

5. WIDE SELECTION... Modernair offers a full range of port sizes, (¼", ⅜", ½", ¾", 1") in single or double solenoid types, for 3 or 4-way operation; solenoids available for either a.c. or d.c. in all popular voltages.

WRITE TODAY for new 20-page condensed catalog (filed in Sweet's 1957 Product Design File, Section 6a/Mo), and applications data; please address Dept. C5

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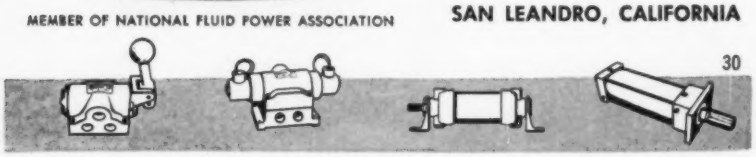
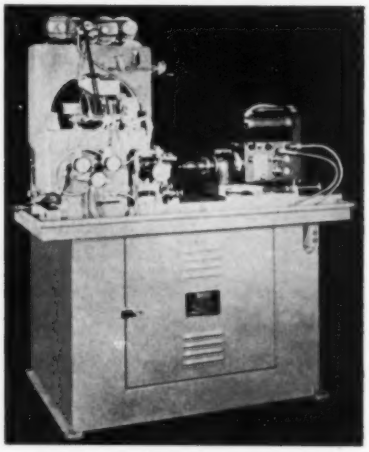
MEMBER OF NATIONAL FLUID POWER ASSOCIATION



30

flow of the coating granulation around the core at the time of deposition in the die prevents core side movement and assures accurate core centering. **Arthur Colton Co., Div., Snyder Tool & Engineering Co.,** 3400 E. Lafayette, Detroit 7, Mich.

Circle 434 on Inquiry Card



Driller and Tapper

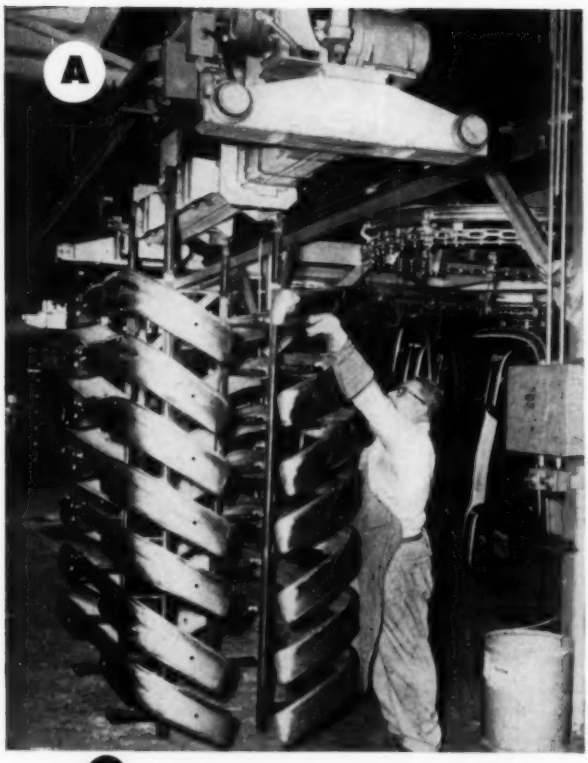
High production rates are afforded by Model 408 Beco automatic drill and tapping machine which is designed for drilling or tapping long rivets, electrical terminals or other similar headed parts. The hopper fed machine accommodates shank lengths from ⅜ to 3¾ inches and shank diameters from 0.090 to 0.375-inch.

Accurate positioning and secure clamping of the work assure straight, concentric axial holes, necessary on thin wall tubular rivets or subsequent tapping. Automatic self-reversing attachments are used for tapping. Production of 30 pieces per minute drilled 7/16 deep in steel, and higher rates in brass or aluminum are possible. Tapping production is approximately 50 per cent faster than drilling. **Batchelder Engineering Co.,** 125 Main St., P.O. Box 159, Springfield, Vt.

Circle 435 on Inquiry Card

Soldering Machine

Called the Braze-O-Matic, automatic soldering machine embodies a new concept in feeding solder automatically through magazines



AMERICAN MONORAIL

teams with *Udylite*

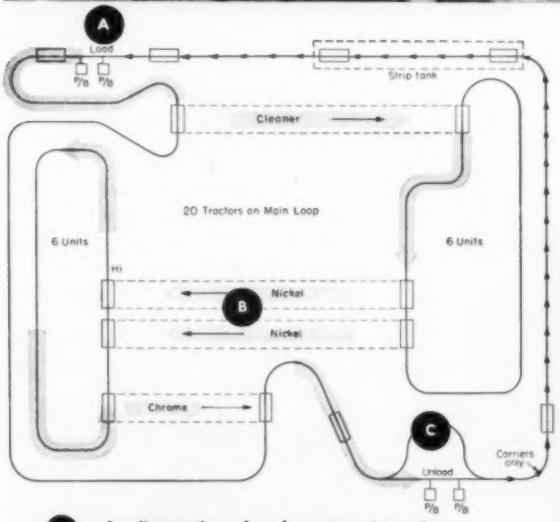
plates auto bumpers at Rheem Automotive plant

Combined engineering skills resulted in substantially reduced handling costs for the plating of auto bumpers at the new Rheem Automotive plant at Fullerton, California.

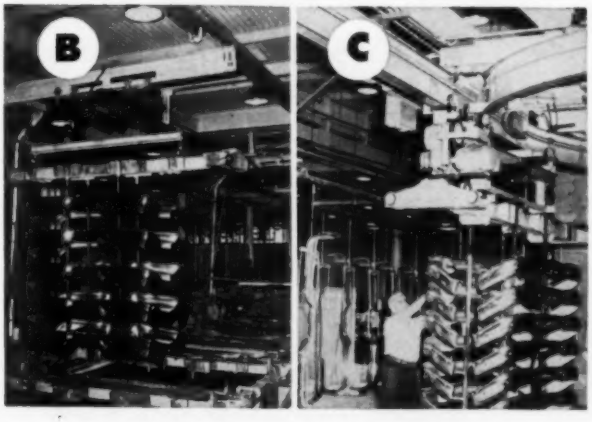
32 American MonoRail automatic dispatch units move special Udylite bumper carriers on three monorail systems with 14 drop sections to maintain continuous automatic plating.

Let American MonoRail engineers combine to solve your handling problems.

Write for Bulletin C-1.



A— Loading station where bumpers enter system.
B— Bumpers move through nickel tanks.
C— Inspection and unloading station.



Member of Materials Handling Institute and Monorail Manufacturers Association

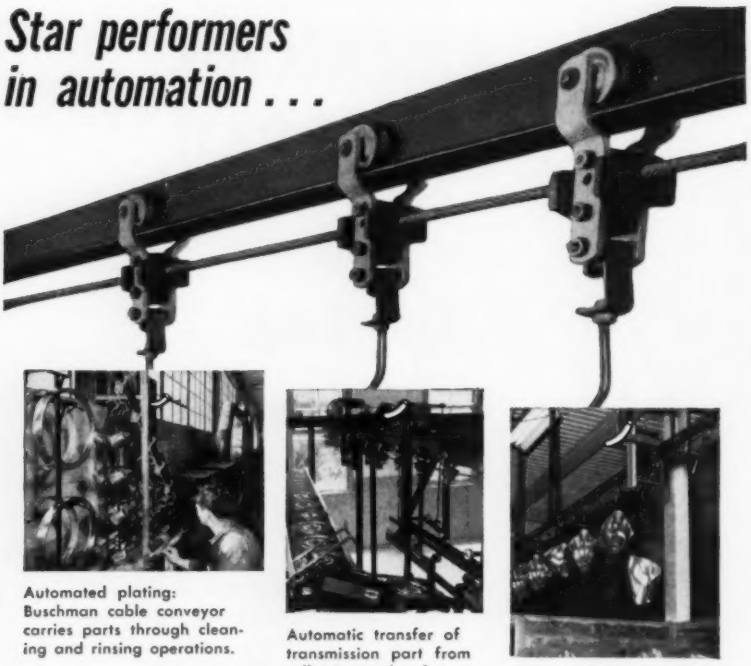
For Power Driven Conveyors, Use Landahl Chainless Conveyors

AMERICAN MONORAIL COMPANY

OVERHEAD HANDLING EQUIPMENT

13144 ATHENS AVENUE, CLEVELAND 7, OHIO (IN CANADA—CANADIAN MONORAIL CO., LTD., GALT, ONT.)

Star performers in automation . . .



Automated plating: Buschman cable conveyor carries parts through cleaning and rinsing operations.

Automatic transfer of transmission part from roller to overhead cable conveyor.

Truck axle housings automatically discharged by types and sizes at pre-selected locations.

BUSCHMAN CABLE CONVEYORS

★ Low initial cost

★ Trouble-free operation

★ Outstanding versatility

. . . long have made Buschman "Universal" Cable Conveyors industry's first choice for everyday transportation of light and medium loads.

Today . . . for the same reasons . . . industry specifies Buschman Cable Conveyors for automated and semi-automated applications. Buschman facilities include the creative engineering "know-how" to design and produce such auxiliary equipment as dispatch and control centers . . . power-and-free in-process inventory control . . . automatic pickup, discharge and transfer equipment . . . and repositioning devices.

Whether your problem involves automation or dependable everyday transportation, investigate the savings possible with Buschman. Remember . . . *when low-cost production is your goal . . . Buschman is your conveyor.* The E. W. Buschman Co., 4551 Clifton Avenue, Cincinnati 32, Ohio.

Write today for literature.

C-328-EWB

WORLD'S MOST COMPLETE LINE OF CONVEYING EQUIPMENT

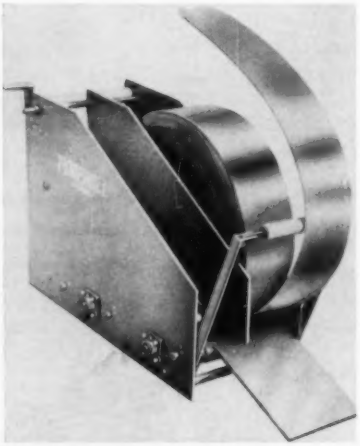
BUSCHMAN CONVEYORS

Circle 617 on Inquiry Card

to preheated parts for solder fabrication. A timing mechanism controls and regulates the flame and the required amount of solder and movement of an index table. It localizes the heat at the point of fabrication in the same manner as it would be done manually, thereby accomplishing high quality soldering at an increased production rate.

The equipment works equally well with all known forms of solder and all types of metals. The machine is designed for one operator and includes a signal system to call for replenishing supplies without delay or downtime. **Castle Machines Inc.**, Erie, Pa.

Circle 436 on Inquiry Card

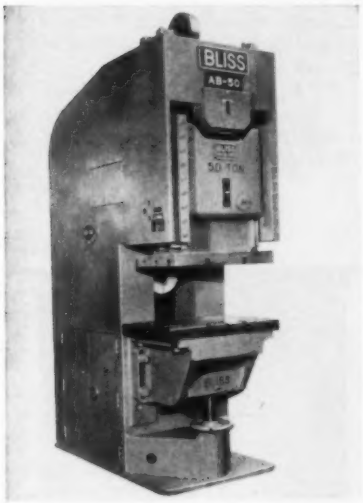


Coil Cradle

Capable of being moved from one press to another wherever the

advantage of an automatic slack loop is desired, Poweroll coil cradle feeds a press automatically. Able to handle coil stock to 24 inches wide by 48 inches in diameter and up to 3000 lb weight, the cradle can be loaded by one man in 1 minute. The metal coil is simply rolled onto the cradle, needing no crane or hoist. The cradle saves floor space since it abuts the press and no space is required for the slack loop. **Medelton Co.**, 335 E. 142nd St., Bronx 54, N.Y.

Circle 437 on Inquiry Card



Adjustable Bed Presses

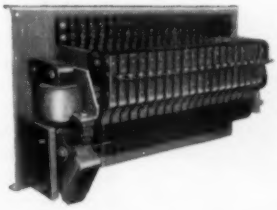
Suitable for a variety of unwieldy stamping and forming work, adjustable bed presses feature a fully enclosed box type frame. The presses have a box crown, box slide and in-building of all controls. Air controls and the recirculating oil unit are enclosed on the left side of the press; the press and motor controls are flush-mounted on the right side. Other features include a fast-acting air friction clutch and brake, and an adjustable rotary limit switch.

Illustrated press is the 50-ton model; line includes capacities ranging from 50 to 100 tons. The 18 by 24-inch bed of the 50-ton model can be raised or lowered a distance of 9 inches, making possible a shut height adjustment from 11 to 20 inches. **E. W. Bliss Co.**, Canton, O.

Circle 438 on Inquiry Card

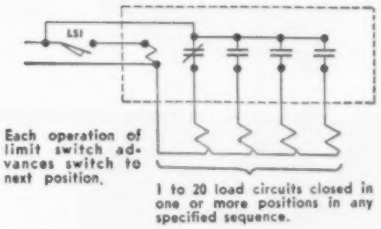
NEW EAGLE STEP SWITCH SIMPLIFIES CIRCUIT SEQUENCING

. . . for machine tools, presses, conveyors, processes

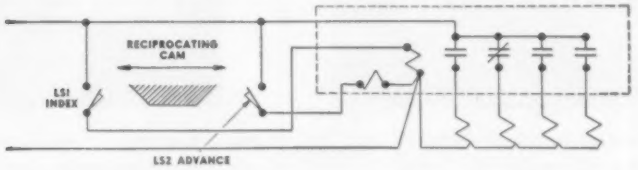


These 3 basic ideas are yours for simplified interlocking or sequencing of multiple load circuits. Any and all three will eliminate many other electrical components, and cut your initial cost.

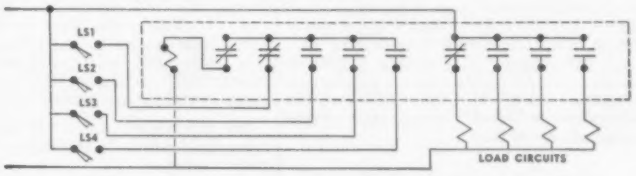
Operating load circuits in sequence: A limit switch on a machine or indexing device closes and opens upon each operation to advance the Eagle step switch. Or a timer may be used to operate each load circuit for a predetermined time.


LSI
Each operation of limit switch advances switch to next position.
1 to 20 load circuits closed in one or more positions in any specified sequence.

Interlock sequence: *Two limit switches* are operated alternately. This provides a safety feature. It insures that the movement of the machine has been completed before the Eagle step switch advances.



Interlock sequence with several limit switches: Each limit switch advances the Eagle step switch one position. Switches must operate in sequence or the step switch won't advance.

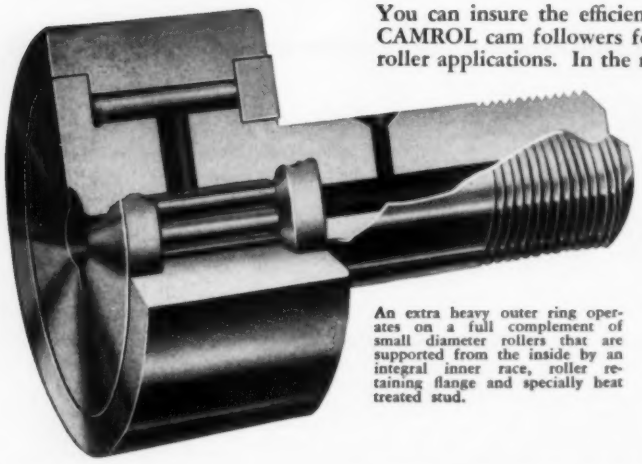


Send for new Eagle Bulletin 850. Simply write to Eagle Signal Corporation, Industrial Timers Division, Moline, Illinois, Dept. A-557.

Circle 618 on Inquiry Card

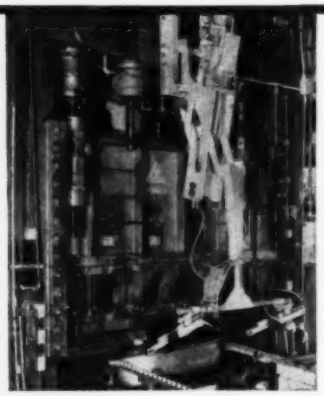
AUTOMATION TIPS by McGill

Insist on CAMROL® bearing advantages when planning your automation



An extra heavy outer ring operates on a full complement of small diameter rollers that are supported from the inside by an integral inner race, roller retaining flange and specially heat treated stud.

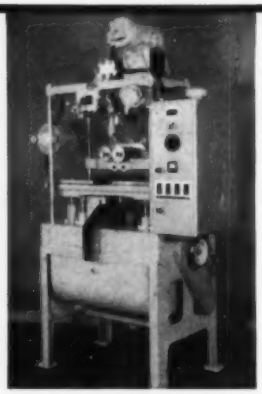
You can insure the efficiency of your automated production by specifying CAMROL cam followers for cam action, track roller or guide and support roller applications. In the machinery you specify or in your own automated operations, CAMROL bearing quality guarantees dependability and longer bearing life. Their ability to withstand intermittent shock and heavy radial loads, space economy, ease of installation, simplified lubrication and balanced hardness and toughness recommends CAMROL cam followers for the critical anti-friction requirements of automation. You can eliminate downtime due to premature failures of improvised units or ordinary bearings. Insist on CAMROL CF or CYR (without stud) bearings. Both types are available in a wide range of standard sizes as are the sealed SCF and SCYR series.



Camrol bearings eliminate bearing trouble for Sahlin iron hand unloaders.

Sealed CAMROL SCF bearings on the upper arm assembly travel a confined cam track to provide direction and support for the unloading arm. Here the IRON HAND machine is shown removing 120 lb. bathtub blanks from a forming press onto a conveyor for additional automatic operations. The Sahlin Engineering Co., Inc. that supplies this unique press unloader to automatic press operations, adopting CAMROL can followers has virtually eliminated bearing replacement under all conditions.

SEND FOR CATALOG 52-A



Camrol bearings show no apparent wear after three years use in automatic packaging machines.

The Kartridg-Pak Machine Co. uses McGill CAMROL bearings in the main drive mechanism of a packaging machine that also forms the container from thermoplastic film. This machine automatically forms, fills and closes 1800 packages of food or other semi-fluid products per hour. Dependability and accuracy of the free rolling and easily lubricated cam followers help guarantee the efficiency of these automatic operations.

After three years of use in this application, the CAMROL bearings show no apparent wear.

Camrol bearings assure greater speed and accuracy in shear-speed shapers.

Michigan Tool Co. uses CAMROL CF and CYR bearings in Shear-Speed Shapers that automatically produce gears up to 20 inches in diameter and up to 6 inch widths in only 13 minutes. These bearings, acting as cam followers, accurately control the feed of all cutting tools simultaneously and relieve these tools from the work on return strokes. They insure dependable, precision performance for automatic operations at high production speeds in these largest production gear cutting machines ever built.

Insure performance with McGILL®

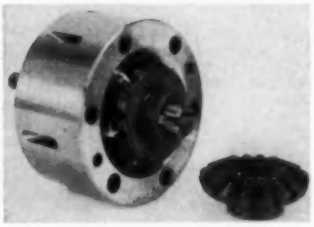
MULTIROL® GUIDEROL® CAMROL®
Precision Needle Bearings

McGILL MANUFACTURING COMPANY, INC., 401 N. LAFAYETTE ST., VALPARAISO, INDIANA

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems

For detailed information and literature, use card page 17

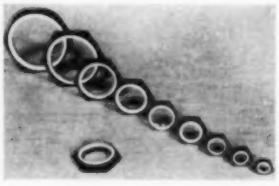


Bevel Gear Chuck

Designed especially for use on a cylindrical grinder equipped with an automatic loader, bevel gear chuck is used for grinding a hub diameter and gear face at one chucking. The unit insures concentricity and uniform height of back face, thus improving quality and reducing subassembly and final assembly costs.

In operation, the chuck receives a gear from the loader, places it on locating pins, and clamps it securely for grinding. After the grinding operation is completed, the chuck releases the gear and ejects it into a finished work receiver. It then picks up a new part and starts through the cycle again. **Garrison Machine Works Inc.**, Dayton 4, O.

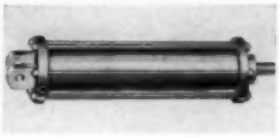
Circle 439 on Inquiry Card



Pipe Fitting Seal

Designed to eliminate leaky pipe connections, self-sealing, nut-like metal fitting seals instantly and permanently when threaded onto a standard pipe connection. Sealing is accomplished by a dry, white circular insert of Teflon plastic, which is resistant to temperature and chemically inert, adapting it for lines carrying oil, water, gas, air, steam, chemical fluids, milk or other beverages. The Tru-Seal fitting holds its seal under ultimate pressures of 10,000 psi and temperatures from −200 to 500F. **Tru-Seal Div., Flick-Reedy Corp.**, Melrose Park, Ill.

Circle 440 on Inquiry Card

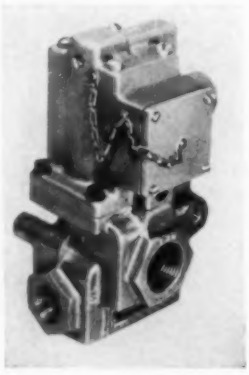


Air Cylinder

Designed to give long life under severe conditions and to facilitate maintenance on the equipment with simple tools, air cylinder is a heavy duty unit. The capsule type gland of alloy steel has a long rod guide and independently adjustable V-rod packing. A bronze rod wiper ring prevents foreign material from entering the cylinder.

Cylinder heads are cut from steel plate. Heads, steel clevises and steel pistons are cadmium plated. Operating pressures are 150 psi on air and 500 psi in hydraulic service. A six-tie rod cage protects the cylinder barrel in rough service. The devices are available in strokes up to 18 ft, from 3 through 8-inch bore, and with a wide choice of piston rod sizes. **Densmore Engineering Co.**, P.O. Box 1557, Oakland 4, Calif.

Circle 441 on Inquiry Card



Solenoid Air Valve

Pilot operated, three way, in-line solenoid controlled air valve features four watertight and dust-tight solenoid enclosures. The valve has a recessed pin which can be locked in or out, to operate the valve manually without removing the cover. Lightweight aluminum construction and in-line cylinder and inlet ports allow mounting the valve directly to a cylinder, to reduce required piping and air.

The device can be used in pairs (one normally open and one normally closed) to control double-acting cylinders. The valve is furnished in ¼, ⅜, ½, ¾, 1 and 1¼-inch sizes, either normally open or normally closed with continuous duty solenoids. **Automatic Valve Co.**, 37415 Grand River Ave., Farmington, Mich.

Circle 442 on Inquiry Card

Subminiature Relay

Designed with lug arrangements for use on printed circuits, MR subminiature type relay features adaptability for easy, rapid assembly. The relay can be adjusted for as low as 10 milliwatts pull-in and

is equipped with solid brass terminals, plated or nonplated as desired, with sufficient free length beyond the surface of the terminal board on the relay to facilitate connection in the circuit board without interference.

Contacts, which are of fine silver or of a suitable noble metal alloy, permit upwards of 25w of power control for noninductive applications. The relay projects slightly less than 1 inch beyond the shoulder of the printed circuit lugs. **Jaidinger Mfg. Co. Inc.,** 1921 W. Hubbard St., Chicago 22, Ill.

Circle 443 on Inquiry Card

Magnetic Amplifier

Suitable for amplifying signals from thermocouples, strain gages, photoelectric cells, demodulators, and instrument pickoffs, Type MA-61 magnetic amplifier is a stable dc unit which operates from 60 cycle, 115v rms line. The amplifier features a linear, reversible output. Having an infinite internal gain, the amplifier is stabilized by current or voltage negative feedback external to the amplifier. The feedback parameters determine the overall gain of the amplifier which may be varied over a wide range. The feedback may be arranged to make either the load current or load voltage independent of changes in the load value.

The amplifier has a maximum power rating of 25 milliwatts and is made for driving meter movements, electrohydraulic valves and power amplifiers. It is useful for mixing two or more input signals and for providing a buffer between a high impedance signal source and a low impedance load. **Dynamics Research Associates,** P.O. Box 5841, Ferguson 21, Mo.

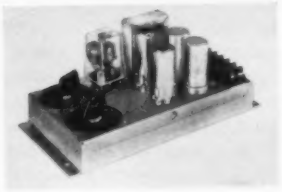
Circle 444 on Inquiry Card

Rotary Pumps

Suitable for handling corrosive liquids, fluids at 375F, water, fuel oil, hydraulic oil, gasoline, detergents, insecticides, and many chemicals including ammonia, rotary vane type positive displacement pumps have capacities of 35 to 275 gal per hour, at pressures up to 300 psi.

Units are made of bronze and carbon graphite, stainless steel and carbon graphite, and aluminum and carbon graphite. The absence of metal-to-metal contact makes the pumps quiet and nonpulsating, resulting in long operating life. The rotary devices have a built-in adjustable relief valve. **Procon Pump & Engineering Co.,** 12721 Capital Ave., Oak Park 37, Mich.

Circle 445 on Inquiry Card

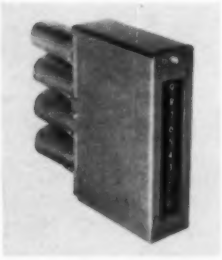


Temperature Controller

Developed to improve regulation of calibrating baths, ovens, extruders, incubators, press platens, etc., by providing extremely close *On-Off* action, Model 63 electronic temperature controller has a differential of ±0.1F for all ranges. Its small size, easy installation, simple maintenance and ease of adjustment also make it applicable for building into equipment which requires accurate temperature control.

Unit is available in several temperature ranges from −100 to +500F, and can be installed remote from the sensing element and grouped in standard conduit boxes for multiple control applications. The power supply is self-contained in each unit, and control action is virtually unaffected by line variations between 105 and 125v. More than 10 thermistor probes ranging from 3/16-inch stainless steel tubular spring loaded units to hypodermic needles, and suitable for gases, liquids, and solids are available for use with the temperature controller. **Yellow Springs Instrument Co. Inc.,** Yellow Springs, O.

Circle 446 on Inquiry Card



Decimal Counter

Used for servocontrol, net weighing, digital position control, ratio control, subtractive mixing, frequency deviation measurement, random events difference counting, digital to analog conversion, computer arithmetic elements, etc., electronic decimal counter is called the Add-Tractor. The device counts, adds and subtracts. It can accept digital information serially as a unitary pulse train, or in parallel in binary coded decimal form. Unitary and binary coded decimal electrical outputs permit the calculating of arithmetical problems and provide a means of control for industrial processes. The readout can be nondestructive of the stored value and the latter is also visually displayed in uncoded decimal. Unitary decimals can be counted at rates up to 100,000 per second. In addition to functioning as an accumulating register, it can also be operated as a left and right shift register. **Victor Adding Machine Co.,** 3900 N. Rockwell St., Chicago 18, Ill.

Circle 447 on Inquiry Card

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The cowman achieves speed and power in a good "using" horse by years of careful breeding . . . Greenlee develops these same qualities in its Bar Automatics by continuous research and design improvement. One of the many superiorities of this speed and power is that it enables you to take full advantage of modern tooling practices. Your Greenlee representative will be glad to show you how it is done. Please submit print when inquiring about a specific job.

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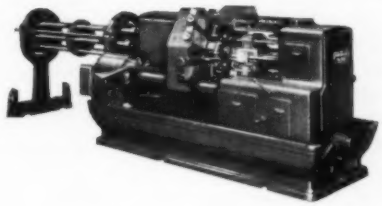

SIX AND FOUR-SPINDLE AUTOMATIC BAR MACHINES

GREENLEE Special Machine Tools

- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Hydro-Borer Precision Boring Machines

GREENLEE BROS. & CO.

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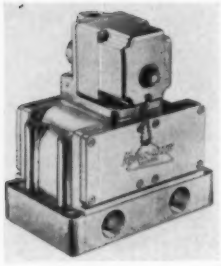
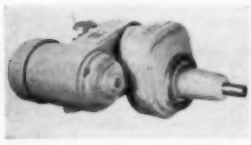


Air Control Valves

Available for pressures to 150 psig, for two, three and four-way operation with master (air), or single or double solenoid pilot control, poppet type air control valves incorporate the Flow-Director which provides automatic selection of pilot air pressure supply from whichever port is used as inlet. This feature eliminates the need for purchasing special valves for each application or reassembling parts to obtain desired operation.

Because pilot pressure is always supplied to the control head automatically, any three-way valve can be piped normally open or normally closed to pressure simply by piping to the proper port. Any four-way valve can be piped with pressure to either of two inlet ports, thus changing the flow pattern through the valve and eliminating criss-cross piping. To further simplify piping, all three-way valves have two cylinder outlet ports and four-way valves have side or bottom porting. Pilot head interchangeability is another feature of the valves. Any pilot head can be used on any valve, regardless of type or size. **Nopak Div., Galland-Henning,** 2734A S. 31st St., Milwaukee 46, Wis.

Circle 448 on Inquiry Card



Variable Speed Motor

Increased radial load capacity is a feature of Speed-Trol variable speed motors with reducers. Larger load capacity is accomplished through extended bearing construction on the speed reducer. The distance between bearings on the output shaft has been lengthened, thus increasing both radial load capacity and rigidity. Speeds are furnished from 350 rpm through 20 rpm in both constant and variable speed models.

The design feature minimizes the need for secondary support bearings. On agitator drives, a rigid coupling can directly connect the reducer shaft to the paddle shaft and the pilot bearing can be omitted. Chain drive sprockets can be mounted a greater distance out from the mounting feet, increasing machine clearance. **Sterling Electric Motors Inc.,** 5401 Telegraph Rd., Los Angeles 22, Calif.

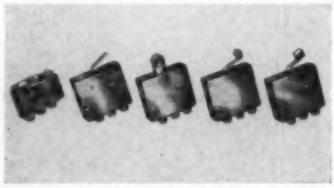
Circle 449 on Inquiry Card

Preset Counter

Designed for industrial counting applications and capable of counting from 0 to 5000 counts per second without special adjustment or circuit changes, electronic preset counter is designated MEK-2094-AG. The device operates with photoelectric, semiconductor, magnetic, or contact making pickups. At the end of the warning and final count, plug-in relays are energized for control purposes. The warning circuits can be used to slow down the process to insure accurate control or to provide notice that the preset number is about to be reached.

After reaching the end of the count, the counter can be reset to zero by several methods: Manually by pressing the local reset button; automatically, either immediately or after the expiration of a built-in adjustable time delay. It is also possible to have the counter reset immediately and at the same time to have the control relays remain energized until reset by one or the other of the listed methods. **Machinery Electrification Inc.,** Northboro, Mass.

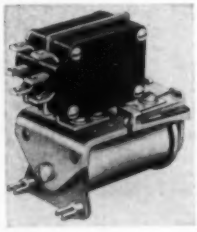
Circle 450 on Inquiry Card



Switch Actuators

Designed for use in industrial controls and other applications requiring complete operational freedom from all environmental conditions, Klixon KX4 sine switches have wider applicability through use of roller and leaf actuators. Neck mounted pushbutton and roller pushbutton actuators are also available for the switches. Basic switch for the actuating units has current ratings of 10 amp resistive, 115v ac/30v dc. **Spencer Thermostat Div., Metals & Controls Corp.,** Attleboro, Mass.

Circle 451 on Inquiry Card

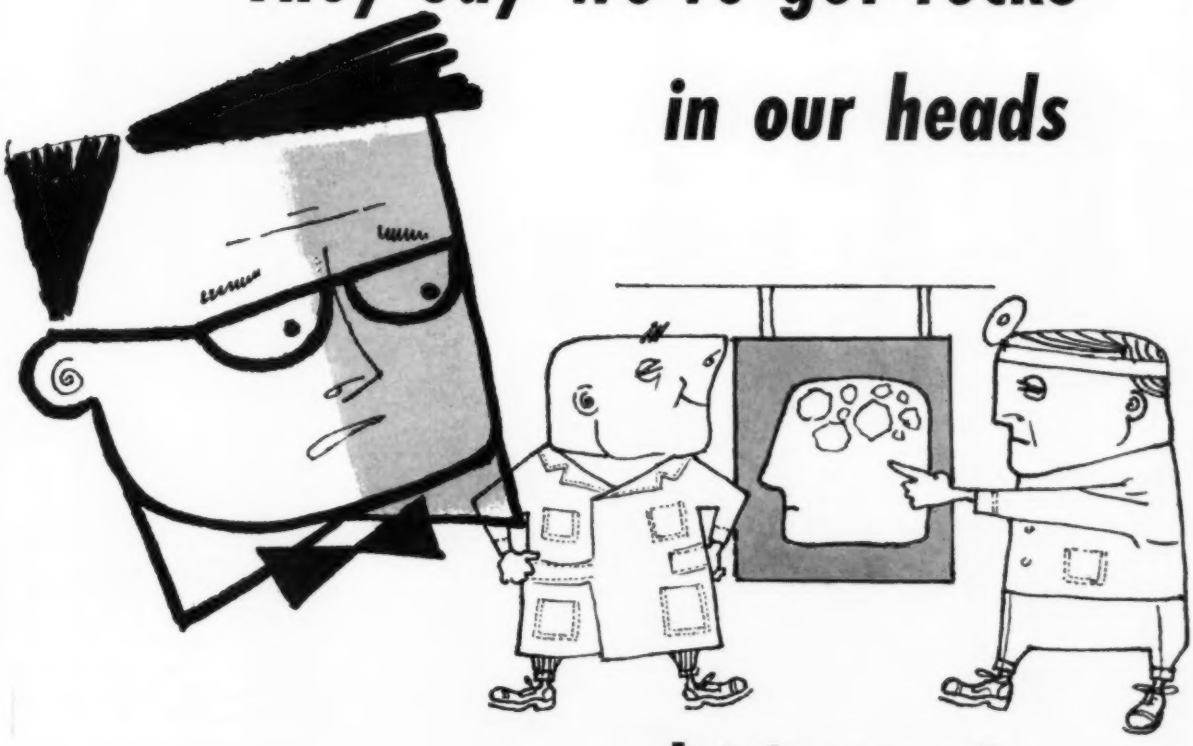


Snap Action Relay

Enclosed snap action contacts are a feature of open type relay designated as Class 22SA. The relay has a contact rating of 10 amp at 115v ac, noninductive load. It can be furnished with one snap action switch for single-pole, double-throw contacts, or with two switches for double-pole, double-throw contacts. The relay is also available with plug-in mounting. It is furnished for dc operation to 230v; 60 cycle ac to 440v. **Magnecraft Electric Co.,** 3354D W. Grand Ave., Chicago 51, Ill.

Circle 452 on Inquiry Card

They say we've got rocks in our heads



—and it's true!

We really don't mind this sort of talk. It's our business to have the types of "rocks" on our minds that are saving millions of dollars in the finishing of manufactured parts.

Roto-Finish people have studied abrasive chips and compounds since the day they pioneered the idea of precision barrel finishing. The development of new and better media for specific finishing problems has made Roto-Finish the leader in mechanical finishing. Years of research and experience in barrel finishing techniques give Roto-Finish the "know-how" to recommend the right media to do the job you want done.

If you're not satisfied with your finishing production, look to Roto-Finish for the answer. Simply send samples of your unfinished parts, a finished part, a description of your production requirements and a list of the equipment you have available. We'll prove that you can save with Roto-Finish and we'll guarantee the same results in your plant that are achieved in sample processing.

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FOREIGN REPRESENTATIVES: CANADA — Toronto — Canadian Hansen & Van Winkle Co., Ltd., Cor. Silver and Morrow Aves. ENGLAND — Mark Road — Hemel Hempstead — Hertfordshire — Roto-Finish Ltd. AUSTRALIA — Cheltenham, 89 Tulip St., A. Flavell Ltd. HOLLAND — BELGIUM — LUXEMBURG — Delft, Holland — N.V. Roto-Finish Maatschappij Rotterdamseweg 370A ● AUSTRIA, GERMANY, SWITZERLAND, NORWAY, SWEDEN Frankfort a.M.—Metallgesellschaft A.G., Germany — Reuterweg 14 ● ITALY — Milan — Societa Roto-Finish a R.L. — Sestos S. Giovanni — Viale E. Marelli 31 ● FRANCE—Paris Societe Roto-Finish, 40-42 rue Chance Milly—Clichy, (Seine) ● BRAZIL — Rio de Janeiro — Commercial E. Industrial de Formos Werco, Ltds. rua General Gurjao, 326 ● SPAIN — Barcelona — Institute Electroquimico, S.A. — Corcega 59.

Control Valve

Used on automatic feed mechanisms, accurate filling operations, pilot control of main valves, pilot for diaphragm valves, control of single-acting cylinders and timing mechanisms, Micro valve functions as either a two-way shut-off or a three-way control unit. The valve employs an overcenter, snap action control which enables it to be installed in automatic reciprocating systems similar to that used on surface grinders where self-reversal of directional control is required.

Because of its small size and sensitive actuation, the valve as a pilot can act in place of limit switches and control main valves with the hydraulic or pneumatic power source already existent. The valve may be used in air, gas, oil and water services. Operating pressures range from 0 to 100 psig. Maximum travel of toggle is 8 degrees either side of center. **Barworth Inc.**, Seven Industrial Place, Summit, N. J.

Circle 453 on Inquiry Card

Fluid Cylinders

Rated at 250 psi for pneumatic use, or up to 1000 psi for hydraulic, Squarehead *S* line of fluid cylinders is available in seven bore sizes up to 6 inches. The rod end of the cylinders features a quick change rod cartridge which is locked to the head by a tightly coiled stainless steel spring which is seated in matching grooves in the head and cartridge. By removing one screw, this spring can be stripped out and the rod cartridge removed, which allows the quick replacement of a worn rod seal or the rod cartridge itself, if necessary. The cylinder features full floating cushions to eliminate misalignment and provide a better fit between cushion members. **Lindberg Air and Hydraulic Div., Teer-Wickwire & Co.**, 1813 Wildwood Ave., Jackson, Mich.

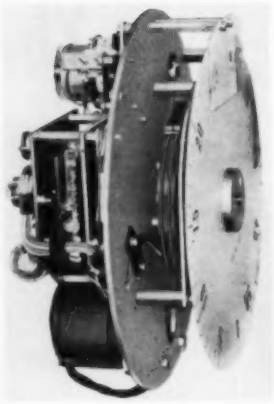
Circle 454 on Inquiry Card

Electronic Counter

Plug-in electronic decade and five-digit mechanical register are combined in 7-lb portable electronic counter. The design consists of an input amplifier, pulse shaper, plug-in electronic decade unit and register. Capable of counting rates up to 12,000 counts per minute, the unit is well suited for a variety of testing and measurement problems. It meets counting needs which are beyond the speed of ordinary electromechanical counters, but do not require the counting speed of multidecade electronic counters.

The counter responds to electrical pulses of 2.5v peak, such as derived from a photocell or magnetic pickup, or will respond to ordinary contact closure. Count capacity is 999,999 counts, with an accuracy of ± 1 count. The counter operates on 105 to 125v ac, and has 90v dc accessory power available for the operation of photocells, etc. **Performance Measurements Co.**, 15301 W. McNichols Rd., Detroit 35, Mich.

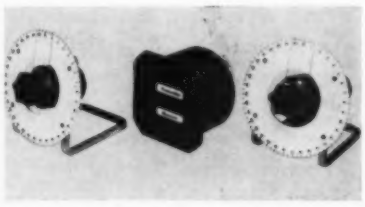
Circle 455 on Inquiry Card



Potentiometer

Used as an indicating pyrometer, resistance thermometer or potentiometer to be incorporated into user's equipment, as a replacement for a direct deflecting dc milliammeter or millivoltmeter, or to operate analog-to-digital conversion mechanisms for readout, electronic potentiometer servomechanism is a self-balancing device. The servomechanism consists of a group of standard Dynamaster instrument parts assembled on a circular base, and fitted with an indicating scale. When used with a Bristol amplifier, input transformer, and Syncroverter dc-ac inverter, it forms a complete self-balancing dial indicator. The unit is available as a potentiometer or as an ac bridge. Dial indicator speeds of 1 second, 3 seconds and 4½ seconds are offered, and one blind set alarm switch can be furnished. The unit can also be supplied with a retransmitting slidewire. **Bristol Co.**, Waterbury 20, Conn.

Circle 456 on Inquiry Card



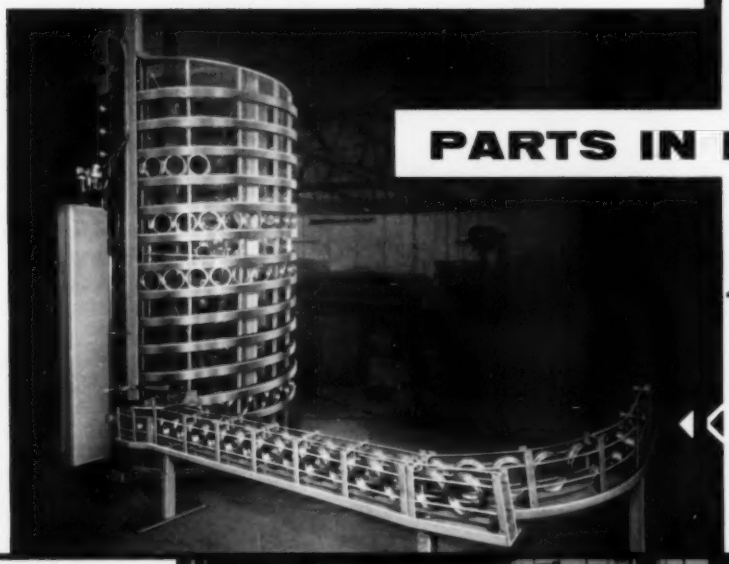
Positioning Device

Featuring a new design concept in repeater units, remote positioning device is called the Torsynator Model 11. The control network

For automating

PARTS IN PROCESS...

...with { *demand control*
selective feeding
active storage
positive movement



Gear-O-Mation's rotary storage units for parts that can roll. Pneumatically loaded double threads (retaining tracks) store parts for true "as-required dispensing". Custom built for high capacity (Bulletin GO-567).

Gear-O-Mation's high speed equipment for the automatic "basketing" of parts removes a slow-down point of processing. Assembled from standard components, the units are custom-tailored—this one loads center-bored pinions at 3000 per hour (Bulletin No. GO-568).

Gear-O-Mation's process stabilizing unit—a parts bank to insure production continuity. Recently developed for use between operations, the equipment forms an integrated "demand feeding" system. It will check, store and feed from one to more than 5000 cylindrical parts depending on size (Bulletin No. GO-561).

Imaginatively engineered equipment, functionally designed to extend the scope and application of automated production systems, is now in manufacture at Gear-O-Mation. Not just work-handling or transfer units, but packaged units that offer positive control at any point installed. Gear-O-Mation also manufactures part washers, size classifiers, machine loaders and unloaders, elevators, and other equipment—for semi- or full automatism in large or small plants. Write us for details.

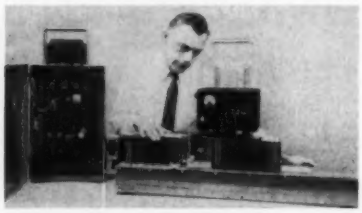
GEAR-O-MATION
DIVISION OF MICHIGAN TOOL COMPANY
7171 E. McNICHOLS RD. • DETROIT 12, MICH.

Circle 622 on Inquiry Card

consists of two 360-degree precision wound potentiometers. Each potentiometer has four taps 90 degrees apart. The transmitter consists of one potentiometer; the other potentiometer is an integral part of the receiver. The network is a self-balancing bridge type device.

The two potentiometers can control dc motors of various horsepower. The maximum follow-up rate of the receiver is 60 degrees per second. Response rates of 60 degrees per second can be exceeded by gearing the transmitter output shaft to the desired value. **Air Marine Motors Inc.,** Amityville, N.Y.

Circle 457 on Inquiry Card



Package Inspector

Developed to inspect a large variety of packages for uniformity, package inspector is based on the use of high frequency current passing through the entire package. All materials respond to this current in proportion to their own electrical properties, as well as to the volume of the materials present.

High frequency current usually permeates through the package itself, measuring the quantity of most materials by allowing current to flow in proportion to the amount of material present. Since some materials conduct electrical current more efficiently than others, it is also possible to single out certain materials inside a complicated package, and determine if they are present in the wanted quantity, ignoring other materials in the package.

Products that can be checked with the inspector include: crackers, spices, breakfast cereal, bottled liquid in a carton, polyethylene-bagged items and squeeze bottles, presence of metal cap or tube in a carton. The device is also capable of inspecting packages for such additional qualities as moisture content, when all other factors are under close tolerance control. **Photobell Sales Corp.,** 43 Vesey St., New York 7, N.Y.

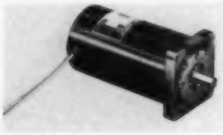
Circle 458 on Inquiry Card

Stepless Speed Drives

Stepless speed variations from true zero to 400 rpm are provided by motorized variable speed reducer. The package unit consists of a Zero-Max variable speed reducer built onto a General Electric 48-frame motor. The motor drives the speed reducer through 1:1 helical gears running in oil inside the housing. Eight basic models delivering 10 to 30 inch-lb torque with clockwise or counterclockwise output shaft rotation are available.

Instant speed changes can be made with the lever control while the unit is running or stopped. It can be set at zero output speed with the motor running without heat expression, or it can be run at any one speed without harm to the unit. The standard motor is 115v, 60 cycle, single-phase, and is of open frame, sleeve bearing, drip proof construction; it can be operated in any position. **Revco Inc.,** 1900 Lyndale Ave. S., Minneapolis, Minn.

Circle 459 on Inquiry Card

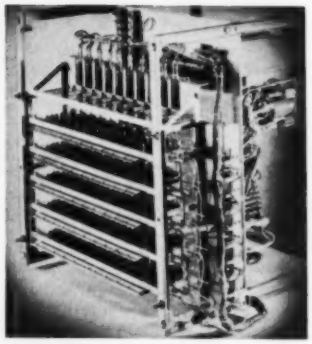


Miniature AC Motors

Available with integral planetary gear reducers and offering 102 ratios between 4 to 1 and 3 million to 1, miniature ac motors are designated Type FC. The units are designed for 115 or 220v ac, 60 or 400 cycle operation. Frame size is 1.675-inch in diameter, and up to 4.5 inches long. The motors are wound for single-phase (with a capacitor) or two-phase operation—two, four or six-pole, and three-phase—two and four-pole.

The gear reduced motors are supplied with induction or hysteresis rotors. The former produces up to 3.5 inch-oz of torque; the latter, operating at synchronous speed, produces up to 1.2 inch-oz of torque. **Globe Industries Inc.,** 1784 Stanley Ave., Dayton, O.

Circle 460 on Inquiry Card



Monitoring Unit

Model 2000SCla Crossbar Scanner is an integrated monitoring device capable of rapid sequential or programed scanning of data points. The scanner features low contact resistance of 0.02 ohm (either gold or palladium contacts are available), low thermoelectric potentials (less than 0.01 microvolt in the range of 25 to 50C), high leakage resistance (where necessary, units with not less than 10^{12} ohms leakage may be supplied), and high frequency performance (cross-talk is 65 db down at 10 megacycles).

The unit is a self-contained instrument capable of scanning in response to a contact closure, 200 points in sequence, one point per control pulse. The 200 points are arranged in ten groups of 20 points each. Facilities are provided to automatically skip any group on command, to start at the beginning of any of the ten groups on command, and to automatically stop at the end of any of the ten groups. **James Cunningham & Sons Co. Inc.,** Rochester 8, N.Y.

Circle 461 on Inquiry Card

CAKE MIX IN A "JIFFY" WITH

CYPAK

Controlling automatic storage conveyors at Chelsea's modern food plant

Chelsea Milling Company, maker of well-known "Jiffy" brand premixed foods, uses flexible CYPAK* static control to reduce material handling costs in their plant at Chelsea, Michigan.

CYPAK begins at the mixing and packaging machines, memorizing the sequence of cartons going to the warehouse. Cartons are identified automatically, and then CYPAK directs storage according to the preselected pattern.

Subsequent delivery of cartons from storage to dock is also completely predetermined, making the warehousing operation totally automatic. An additional benefit realized by Chelsea with this system has been great reduction in carton breakage.

For complete information on CYPAK, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

*Trade Mark
J-22033

YOU CAN BE SURE...IF IT'S

Westinghouse

Mr. Lester L. Bosch, Partner, Bosch & La Tour views their system design.

Stromberg-Carlson's new type "E" relay combines the time-proven characteristics of the type "A" relay with a mounting arrangement common to many other makes.

As the sketch above shows, our new frame mounting holes and coil terminal spacing allow you to specify these relays—*of "telephone quality"*—interchangeably with brands you have been using. Costs are competitive and expanded production means *prompt delivery.*

Welcome engineering features of the new "E" relay are—

★ **Contact spring assembly:** maximum of 20 Form A, 18 B, 10 C per relay.

★ **Coil:** single or double wound, with taper tab or solder type terminals at back of relay.

★ **Operating voltage:** 200 volts DC maximum.

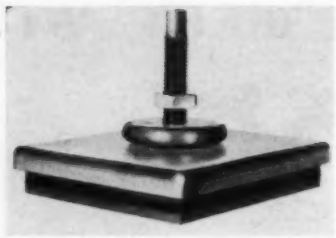
You may order individual can covers in a choice of 3 sizes for the new relay, as well as for our type "A" and "C" relays.

For complete details and specifications on the "E" relay and other Stromberg-Carlson relays, send for your free copy of Catalog T-5000R.

STROMBERG-CARLSON

A DIVISION OF GENERAL DYNAMICS CORPORATION
TELECOMMUNICATION INDUSTRIAL SALES
111 CARLSON ROAD, ROCHESTER 3, N. Y.

Circle 623 on Inquiry Card

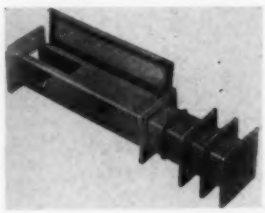


Machinery Mount

Called the Level-Rite, self-leveling machinery mount is applicable in installations which require machine mobility and leveling ease. The mount consists of an all-steel base unit with leveling screw and leveling plate, combined with Unisorb vibration-dampener pad. The device is designed in seven models with loading ranges from 800 to 7500 lb per unit, and in four sizes: 4 by 4 inches, 6 by 6 inches, 8 by 8 inches, and 10 by 10 inches. One unit is required for each machine leg or mounting point.

The mount has two features: A screw-post design by which a machine is quickly and easily leveled, and compression anchoring. The only actions required are to rotate the square top of the screw post to bring the machine to level position, then securing it with the lock nut. Compression provides positive hold, with no machine walking or creeping. The dampener pad reduces transmitted vibration. **Felters Co.,** 210 South St., Boston 11, Mass.

Circle 462 on Inquiry Card

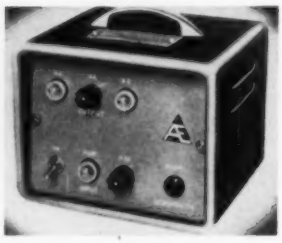


Wireway Fittings

Developed for use on machinery or buildings where oil and dust are problems, oil-tight telescoping wireway fittings are addition to line of 2½ by 2½-inch, 4 by 4-inch, and 6 by 6-inch gasketed wireway. When incorporated into a wireway run, the telescoping section permits adjustment to any desired length.

Illustrated telescoping section is partially assembled into a 1-ft straight section. After adjusting the unit to the proper length, the O-ring gasket and the two sliding retainer plates are bolted to the end flange of the straight section, forming an oil-tight junction. The telescoping section of each of the three wireway sizes is 15½ inches long, and permits adjusting the length of an assembly between 1½ and 13½ inches. **Hoffman Engineering Corp.,** 1802 Tyler St., Anoka, Minn.

Circle 463 on Inquiry Card



Electronic Switch

Developed for inclusion in a variety of electronic control systems, sensitive, heavy duty electronic switch controls up to 500w of power, either delivered at 115v ac, 60 cps, or switched by its internal contacts. Designated as the Model 6330 Controller, the unit can be used with many types of transducers or detector devices, or may be actuated directly by any minute electrical contact. Minimum input impedance is 2 megohms. A rear mounted terminal strip provides maximum flexibility for selection of switching functions. **Autron Engineering Inc.,** 1254 W. Sixth St., Los Angeles 17, Calif.

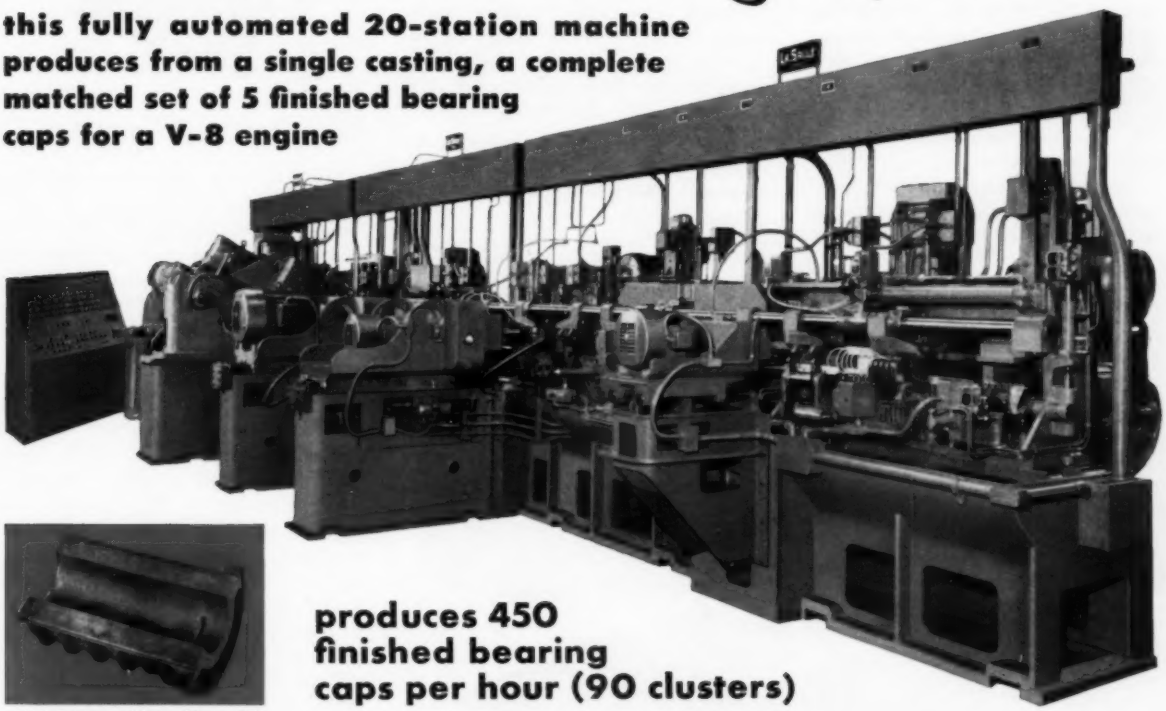
Circle 464 on Inquiry Card

Conductivity Cell

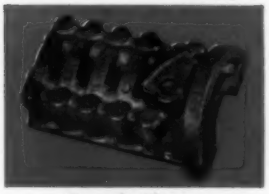
Designed to operate over a range of 30 to 325C and capable of ac-

La Salle bearing-cap-amatic

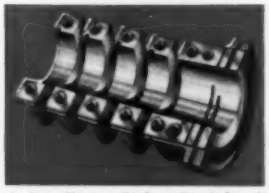
this fully automated 20-station machine produces from a single casting, a complete matched set of 5 finished bearing caps for a V-8 engine



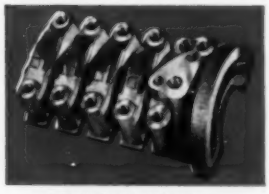
Joint Face Side (Rough)



Rough Cluster



Joint Face Side (Finished)



Finished Cluster

produces 450 finished bearing caps per hour (90 clusters)

1. The bearing cap cluster is shuttled into the load station, then rotated 90° so that the joint face is in a vertical plane. The part is then shuttled through the machine using one edge of the channel fit for vertical location and the joint face for in and out location.
2. End wise location is taken with a vee block on bearing cap No. 3—Then the part is clamped.
   Right hand operation is to mill bearing cap cluster to length—Both ends. Left hand operation—drill (4) ½ Dia. Holes through.
3. Clamp: Right hand operation—Probe 4 drilled holes.
   Left hand operation—Idle.
4. Locate from drilled hole—bearing cap No. 5 and clamp.
   Right hand operation—Mill oil pump Pad No. 5 Vertical.
   Left hand operation—Ream 2 holes bearing cap No. 3 and drill 4 holes.
5. Locate from reamed hole in bearing cap No. 3 and clamp.
   Right hand operation—Idle.
   Left hand operation—Drill 4 holes through and chamfer two holes in No. 5 bearing cap.
6. Clamp: Right hand operation—Probe 9 holes.
   Left hand operation—Idle.
7. Locate from hole in bearing cap No. 5 and clamp.
   Right hand operation—Drill one angular hole half way in oil pump pad bearing cap No. 5.
   Left hand operation—Chamfer 9 holes.
8. Locate from reamed hole bearing cap No. 3 and clamp.
   Right hand operation—Drill one angular hole to depth in oil pump pad bearing cap No. 5.
   Left hand operation—Ream 8 holes.
9. Clamp: Right hand operation—Idle.
   Left hand operation—Idle.
10. Locate from reamed hole in bearing cap No. 3 and clamp.
    Right hand operation—Spot-face 6 bosses.
    Left hand operation—Idle.
11. Locate from reamed hole in bearing cap No. 3 and clamp.
    Right hand operation—Spot-face 4 bosses.
    Left hand operation—Mill one 2" dia. by .120 slot in bearing cap No. 5.
12. Clamp: Right hand operation—Idle.
    Left hand operation—Idle.
13. Locate from reamed hole in bearing cap No. 3 and clamp.
    Right hand operation—Drill and counter-sink 2 holes in oil pump pad—counterbore oil pump shaft hole.
    Left hand operation—Idle.
14. Locate from reamed hole in bearing cap No. 3 and clamp.
    Right hand operation—Probe and blow out 2 holes in oil pump pad—Combination ream oil pump shaft hole.
    Left hand operation—Mill one .120 slot and one .190 slot in bearing cap No. 5.
15. Clamp: Right hand operation—Idle.
    Left hand operation—Idle.
16. Locate from reamed hole in bearing cap No. 3 and clamp.
    Right hand operation—Idle.
    Left hand operation—Mill 5 anchor slots.
17. Clamp: Right hand operation—Idle.
    Left hand operation—Idle.
18. Locate from reamed hole in bearing cap No. 3 and clamp.
    Right hand operation—Tap 2 holes in oil pump pad.
    Left hand operation—Idle.
19. Locate from reamed hole in bearing cap No. 3 and clamp each of the 5 bearing caps independently.
    Right hand operation—Idle.
    Left hand operation—Mill 4 slots through bearing cap cluster, which divides cluster into 5 separate bearing caps. (Shuttle 5 separate bearing caps to station No. 20 —).
20. Unload 5 separate bearing caps, maintaining separation.

La Salle tool, inc.

ENGINEERING & BUILDING
SPECIAL MACHINERY

3840 EAST OUTER DRIVE • DETROIT 34, MICHIGAN

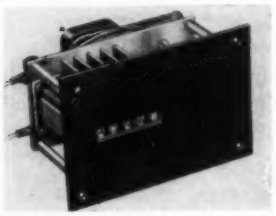
Circle 624 on Inquiry Card

commodating liquids with boiling points up to 425C, high temperature thermal conductivity cell extends the effective operating range of chromatographic analyses. Designated the Model 75, the cell may be incorporated into any existing chromatographic apparatus. Stability and sensitivity are achieved at these high temperatures by the use of flake thermistors as the sensing elements.

The conductivity cell consists of three separate units: (1) The detector proper enclosed in a specially designed oven, designed for minimum drift at maximum sensitivity. (2) The temperature controller, continuously variable from 30 to 350C. Proportional control assures accurate temperature monitoring, freedom from variations in ambient temperature, and independence of fluctuations in line voltage. (3) The bridge circuit and power supply—a Wheatstone bridge for use with flake thermistors. **Barnes Engineering Co.**, Stamford, Conn.

Circle 465 on Inquiry Card

LITTELL
AIR VACUUM UNITS
lift • move • handle
SHEETS or BLANKS
LITTELL
4 CUP CRANE
SUSPENDED
VACUUM SHEET
LIFTER
Based upon a 4 to 1 safety factor, the 4 Cup Sheet Lifter has capacities of more than 1,000 lbs. Other models available.
LITTELL
AIR BLAST
VALVES
Automatic ejection of pieces by using a short blast of air permits the operator to give his entire attention to loading the die, thereby saving time and increasing output.
LITTELL
PRES-VAC
SAFETY FEEDERS
. . . operate on a minimum of air—only 45 lbs. psi and handle parts from 2 to 10 lbs.
LITTELL VACUUM CUPS
14" diameter herringbone faced cup with neoprene rubber.▲
Molded on steel backing plate equipped with 4 mounting holes. Other designs for 6 to 10" diameter available.▼
Standard cups in neoprene or gum rubber sizes ¾" to 5".
Rectangular cups with neoprene rubber molded on steel backing plate. Sizes 2½" x8¾" and 3½" x16".
▼As shown in top illustration. ▲As shown on Pres-Vac.
Write for FREE Catalog!
VAC-U-MATION DIVISION
4105 Ravenswood Avenue, Chicago 13, Illinois
District Offices: Detroit and Cleveland
2571C

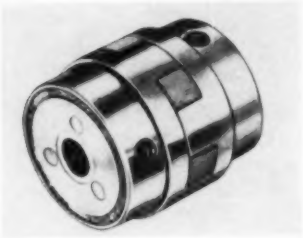


Data Readout Counters

Developed to perform direct indication, remote indication, recording and controlling functions, series of electrical data readout counters can be electrically or mechanically actuated and offer manual or electrical reset. The units automatically create specific contact closures for each reading visually displayed. The devices can be employed to furnish data for remote indication, remote printing or logging, and remote or direct card or tape punching.

Serial or parallel transmission of data can be accomplished through the use of sequence scanners or direct connections. Transmission may be continuous or intermittent with the counter providing data storage. **Veeder-Root Inc.**, Hartford 2, Conn.

Circle 466 on Inquiry Card



Flexible Coupling

Designed for original equipment installation, diecast flexible coupling is known as Type L-093. Installation, removal, assembly or disassemly can be quickly accomplished, since the coupling consists of two bodies with jaws and a one-piece spider type cushion. Dust, dirt, mud, water or similar adverse conditions have no effect on performance. The load is transmitted by cushion compression, so the metal jaws are not subjected to wear.

The cushion spiders out into six load ends which are visible for

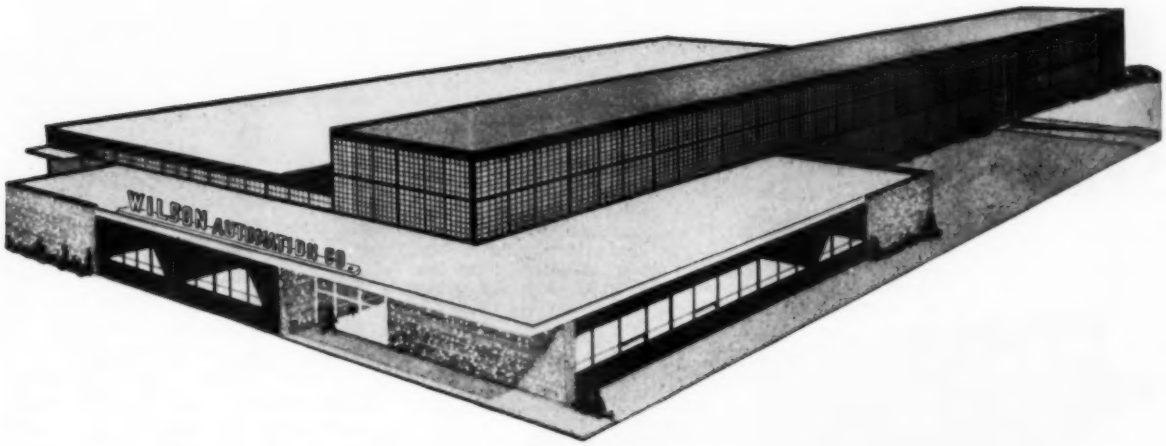
AUTOMATION is more than a new word

with WILSON . . . it's our business

We are one of the pioneers in the revolutionary field of automation. Wilson automation installations are functioning day after day, smoothly and efficiently in some of the largest plants in the nation. We have built automation machines, ranging in size from single units to gigantic lines 4,400 feet long (from 1 ton to 40 tons). Sooner or later, you are bound to get around to the point where you will need automation in your business. When you do, remember Wilson. We have the know-how, the ability and experienced engineering staff to take good care of your problem.

A PARTIAL LIST OF WILSON AUTOMATION USERS

CADILLAC DIVISION — CHEVROLET — DODGE DIVISION — FORD MOTOR COMPANY
GENERAL ELECTRIC — OLDSMOBILE DIVISION — PLYMOUTH DIVISION
PONTIAC MOTORS — STUDEBAKER-PACKARD



THE NEW HOME OF WILSON AUTOMATION COMPANY

This new building was made necessary by the rapid growth of our business, due to the greatly increased demand for Wilson Automation in the automotive and other industries. Modern and functional in design, this new plant incorporates all the facilities and productive capacity for building the most extensive automation lines for the requirements of modern automated production.

We will be glad to discuss with you how Automation can be applied profitably to your specific operations.

WILSON AUTOMATION COMPANY

PIONEER AUTOMATIONISTS

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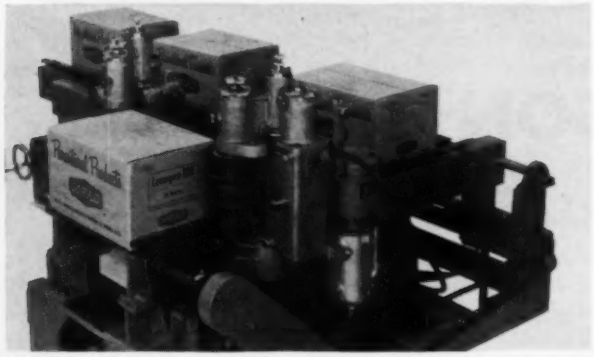
PRINT YOUR "LABEL" RIGHT ON THE PACKAGE

Production-line imprinting machine saves on labelling . . . package costs . . . storage space



Prints anything, from code-date to ad . . . on any package, from tiny carton to shipping case

Are you using fully preprinted packages for every different product in your line? Are you using labels on your package . . . or imprinting it in a separate operation? You can save money by using a Gottscho MARKOPRINTER machine to imprint contents descriptions, parts numbers, varieties, codes, flavors, other changeable legends on one or more blank panels of a common container . . . *automatically* . . . as part of your packaging operation. The MARKOPRINTER machine does away with label and labelling costs, huge inventories of preprinted packages, losses from obsolescence . . assures lower unit package costs, reduced warehousing and record-keeping labor, no down-time due to lack of right packages at the right time.

Write for descriptive Bulletin "MP"

Gottscho

ADOLPH GOTTSCHO, INC.

Dept. H, Hillside 5, N. J.

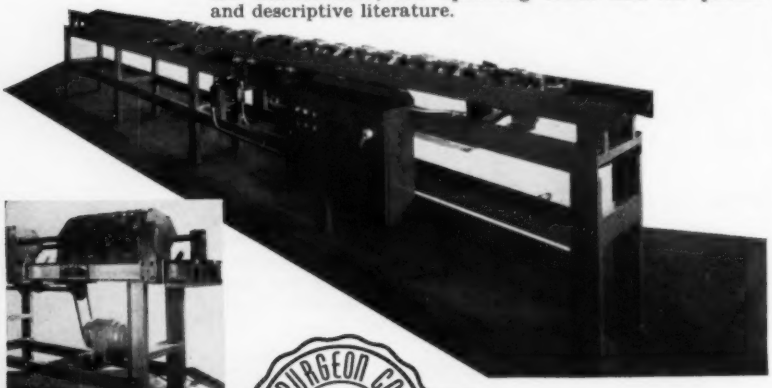
In Canada: **RICHARDSON AGENCIES, LTD., Toronto & Montreal**

Automatic Production-Line
CODING, MARKING, IMPRINTING MACHINES

Circle 627 on Inquiry Card

SPURGEON Electro-Mechanical Drives

In these two instances they are used on shuttle transfers, utilizing motor-driven, high efficiency, ball bearing nut and screw assemblies. Power cylinders have been eliminated. Simple, rugged, clean, efficient, long life; low maintenance; low operating costs. Ask for photos and descriptive literature.



SPURGEON CO. Since 1923 — DO IT AUTOMATICALLY — SPURGEON AUTOMATION — DETROIT, MICH.

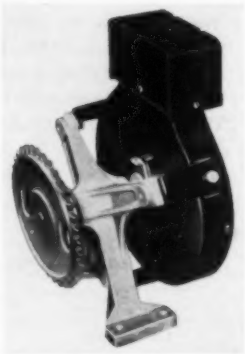
SPURGEON COMPANY

23505 HOOVER RD. SINCE 1923
VAN DYKE, MICHIGAN

Circle 628 on Inquiry Card

quick inspection at all times. On nonreversing loads, only three of the load ends are under compression, while the other three are idling. Thus, the cushion can be reversed for double service life. Ratings of the coupling range from 0.4 hp at 100 rpm to 4.6 hp at 4600 rpm, using standard cushions. **Lovejoy Flexible Coupling Co.,** 4984 W. Lake St., Chicago 44, Ill.

Circle 467 on Inquiry Card



Dancer Roll Rheostats

Engineered for use on multimotor drives where relative speeds between motors must be maintained within specified limits, line of dancer roll rheostats affords a reliable field control method essential to dancer roll service in textile, paper, steel mill and other process machinery. A typical rheostat assembly for shelf, floor or ceiling installation comprises a single or multideck 6, 8, or 13-inch Vitrohm pressed steel rheostat with stainless steel through-shaft, cast aluminum bracket, and is with or without sprocket chain. Sprockets may be removed or added without disturbing the assembly. Control of single or multiple circuits from a single assembly is permissible. **Ward Leonard Electric Co.,** Mt. Vernon, N.Y.

Circle 468 on Inquiry Card

Drill Units

Available equipped for automatic gun drilling, Air-O-Matic drill units afford drilling advantages: Deep holes 5/32-inch diameter and up; shallow holes where straightness, size and finish are crucial; and where speed necessitates a high rate of metal removal and fin-

Let

RACINE

engineer your hydraulic needs

WHY RACINE FACTORY-ENGINEERED, FACTORY-ASSEMBLED *"HYDRAULIC POWER UNITS"* ARE BETTER FOR YOU!

- Designed, engineered and built with Racine-made components to your specific machine operation needs
- Compact — requiring a minimum of floor space
- All components easily accessible for quick servicing
- Complete and ready for immediate hook-up to your service lines
- Control valves positioned on easily accessible, clearly designated control panel
- Field sales and service representatives in all principal cities

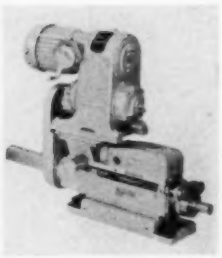
Investigate RACINE'S *free* engineering service. Let Racine Hydraulic specialists relieve your engineering load. It will save you valuable time and money. Utilize this responsible single source of supply. Write us about your hydraulic projects. Your needs will receive prompt attention. No obligation.

RACINE — STANDARD FOR QUALITY AND PRECISION — RACINE HYDRAULICS & MACHINERY, INC.

NFPA NATIONAL FLUID POWER ASSOCIATION Member

RACINE HYDRAULICS & MACHINERY, INC.
2086 Albert Street
RACINE, WISCONSIN

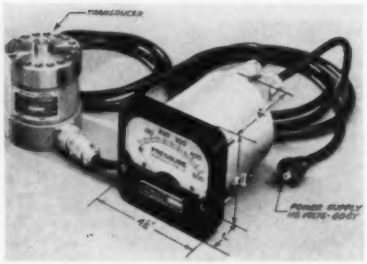
Circle 629 on Inquiry Card



ish is not critical. In the gun drilling, high pressure coolant is forced through the drill to contact the work at the cutting head. Chips and heat are carried away by the coolant, resulting in faster and more accurate drilling with little chip trouble.

Drill units have infinitely variable spindle speeds and feeds which are independent of each other. Spindle speeds up to 8000 rpm can be obtained by adjusting the hand wheel on the motor of the unit. Feeds up to 40 inches per minute are possible, with infinitely adjustable feed stroke available in 6 or 9-inch stroke. The entire unit is adjustable on a sliding base available for 6 or 9-inch movement. Functional feature of the drill is the adjustable load control which detects dull drills, chipped drills, hard spots, and insufficient coolant, as well as aiding in the determination of proper free cutting drill grind. **Morris Machine Tool Co.**, 933-17 Harriet St., Cincinnati 3, O.

Circle 469 on Inquiry Card

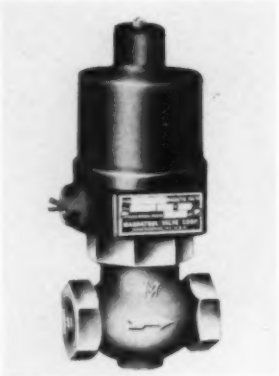


Transducer Indicator

Designed for indicating telemetered information from strain gage type transducers, device is called the Teledyne indicator. The unit consists of a precision dc meter movement and a dc power supply. The latter furnishes excitation to the strain gage measurement of fluid and gas pressures, thrust, torque and similar phenomena where indication and control of the measured force is required to be far removed from the transducer due to a field location of the latter, or where explosion hazards are involved.

The illustrated Model 182 indicator is designed for panel mounting; adjustments of mechanical zero, electrical zero and calibration are accessible from the front of the instrument. Two connectors, one for power and the other for connection to the transducer, are mounted in the rear. **Section 78, Taber Instrument Corp.**, N. Tonawanda, N.Y.

Circle 470 on Inquiry Card



Solenoid Valve

Engineered for the automatic control of water, brine, solvents, gas, air, etc., full port solenoid valve features a completely tight shut-off when the solenoid is energized. Designated as Type AR, the unit is also well suited for the control of vacuum lines.

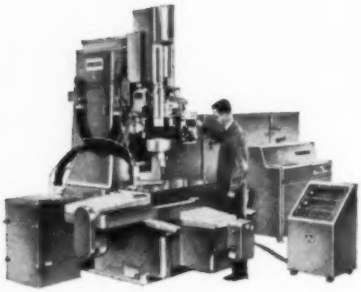
The valve has screwed ends and is available in sizes from ½ to 3 inches with pressure ratings to 300 psi. The valve opens instantly when the solenoid is energized. In opening, a quick acting spring insures positive action. In high-pressure applications, the line pressure assists the spring in providing instantaneous opening. The Type AR has a removable operating assembly which permits quick disassembly of the valve for inspection and cleaning without disturbing either the line or the electrical feed (where flexible conduit is used). **Magnatrol Valve Corp.**, 73 Fifth Ave., Hawthorne, N. J.

Circle 471 on Inquiry Card

PRATT & WHITNEY NUMERICAL CONTROL APPLICATIONS

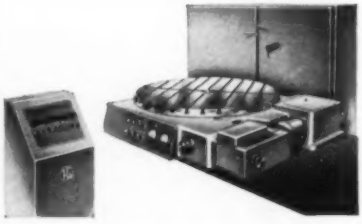
ELECTROLIMIT JIG BORER

Equipped with Numerical Control, the P&W No. 2E Jig Borer is equally suitable for toolroom and precision production applications. Settings accurate to .0001" are made automatically from data supplied by a punched tape or an operator's keyboard.



VERTICAL PRECISION HOLE GRINDER

Table and carriage are similar in design to the No. 2E Jig Borer and the same ultra-precision Electrolimit Measuring System is employed. Column, however, is equipped with interchangeable, turbine-driven grinding heads for spindle speeds to 100,000 rpm.



PRECISION ROTARY TABLES

These Pratt & Whitney Rotary Tables are the ultimate in precision and convenience for circular spacing, graduating and angular positioning. Settings accurate to 5 seconds of arc (2 seconds for repetitive settings) are made automatically from data supplied by punched tape or operator's keyboard.

PRATT & WHITNEY

Circle 630 on Inquiry Card

TO "TENTHS" IN SECONDS

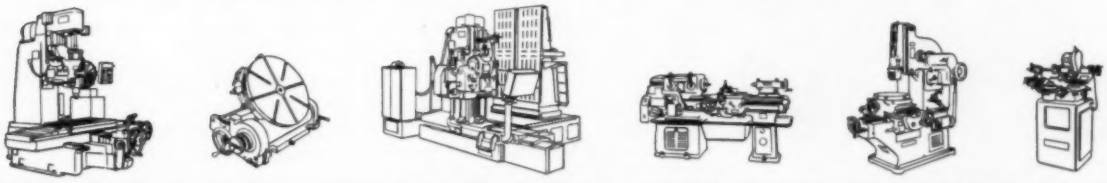
. . . *and no mistakes!*

WITH NEW PRATT & WHITNEY NUMERICAL CONTROL

Operating under Numerical Control, this P&W Precision Hole Grinder is positioned and re-positioned — accurate to .0001" — in an average of only 14 seconds! And since settings are controlled by a punched tape, the chance of work spoilage through operator error in reading blueprint data or setting dials is eliminated. The operator is free to concentrate his attention on work quality.

Applied to Pratt & Whitney Jig Borers, Precision Hole Grinders, Rotary Tables and special machines, Numerical Control not only speeds up toolroom operations, but also makes the high precision of these machines available for efficient short- or long-run production work. In this type work, time savings up to 40% over manual operation are realized. Compare the performance of your present manually-controlled machines with the new standards of speed, accuracy and economy being established by numerically-controlled P&W equipment. If they don't measure up, you are missing important opportunities for improved work quality, larger savings and greater profits.

Write now for complete information.
Pratt & Whitney Company, Incorporated,
35 Charter Oak Boulevard, West Hartford, Conn.

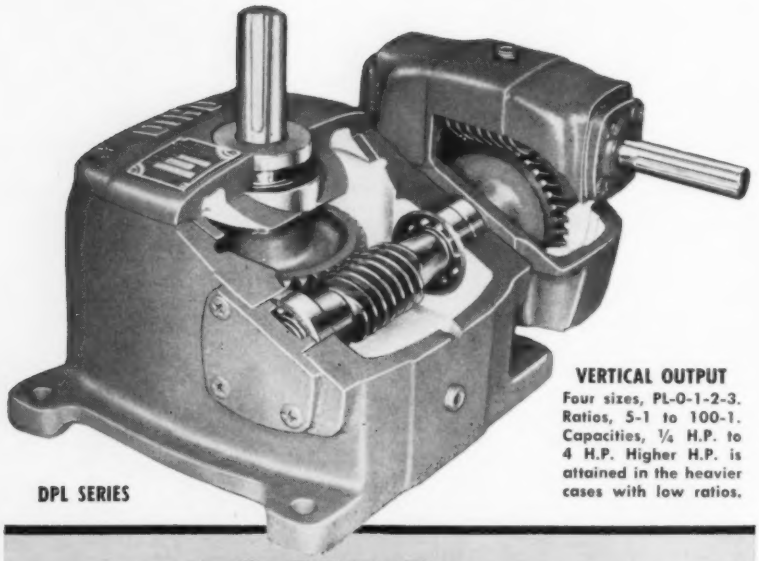


JIG BORERS . . . ROTARY TABLES . . . KELLER MACHINES . . . LATHES . . . VERTICAL SHAPERS . . . CUTTER AND RADIUS GRINDERS

PRATT & WHITNEY

FIRST CHOICE FOR ACCURACY

MACHINE TOOLS • GAGES • CUTTING TOOLS

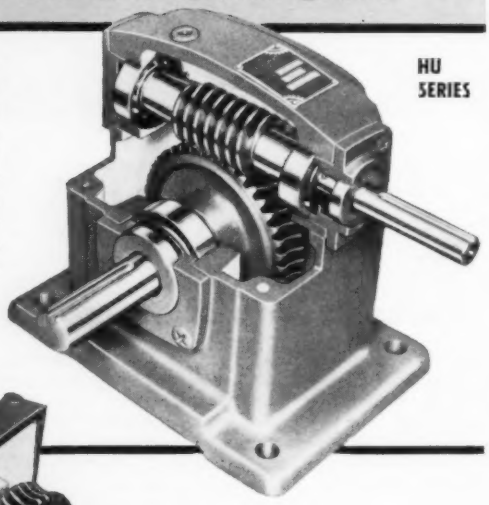


DPL SERIES

VERTICAL OUTPUT
Four sizes, PL-0-1-2-3. Ratios, 5-1 to 100-1. Capacities, ¼ H.P. to 4 H.P. Higher H.P. is attained in the heavier cases with low ratios.

SPEED OHIO REDUCERS
"off the shelf"

• Ohio Stock Speed Reducers have been enthusiastically accepted among nationally known manufacturers for their sound engineering, long economical operation, and found to give the greatest satisfaction under a wide range of Industrial applications.



HU SERIES

WORM ON TOP
Single reducers. Input shaft is above and output shaft below. Includes 5 sizes, HU-0-1-2-3-4. Ratios, 5-1 to 100-1.

D SERIES

DOUBLE SPEED
For heavy duty service, Nos. DOT and D-1-3-4-5-6. Ratios to 3200 to 1. Torque capacities, 25 to 12000 in. lbs.

ESTABLISHED 1915
OHIO GEARS

THE OHIO GEAR CO.
1323 E. 179 ST. • CLEVELAND 10, OHIO

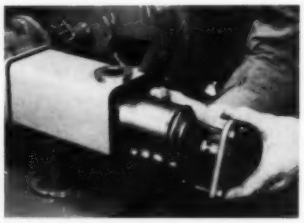
Circle 631 on Inquiry Card

Voltage Supply

Designed primarily as a reference voltage for adjustable speed motor drives and dc servosystems, constant reference voltage supply may be used in some applications to replace standard cells, wet or dry cells, and more extensive electronic regulating systems. The unit converts ac into highly stable dc reference voltage.

When connected to a 115v supply (50 to 400 cycles), the unit supplies a reference potential adjustable from 0 to approximately 87v, and maintains the desired voltage with a stability of better than 1/5 of 1 per cent. This reference voltage is maintained with any load not exceeding 1 ma and throughout a temperature range of −50 to +40C and with line voltage changes from 90 to 135v. **Servo-Tek Products Co.**, 1086 Goffle Rd., Hawthorne, N. J.

Circle 472 on Inquiry Card



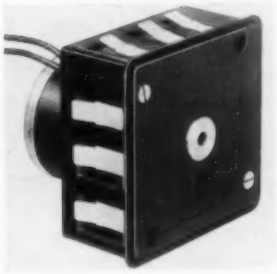
Hydraulic Strainer

Developed to notify the user when the hydraulic strainer is dirt clogged, to act as a by-pass valve to protect the pump, to provide for easy strainer removal and to increase the usable oil supply, device which brings the strainer out of the reservoir to any convenient outside location is called the Telltale Strainer.

A red signal notifies the operator when the strainer is clogged and has been pulled aside by pump suction to allow the free flow of oil around it. Automated setups can use an optional limit switch

for a remote signal light. The strainer is easily removed since it is held in place by the bolted-on end plate. Use of the strainer increases the oil supply because the oil inlet pipe, which no longer carries a strainer, can be lowered farther into the tank. **Rosaen Co.**, 1776 E. Nine Mile Rd., Hazel Park, Mich.

Circle 473 on Inquiry Card



Cycling Timer

Small size, design simplicity, and a wide range of speeds are features of Type 571 cycling timer. With contacts for 30 amp resistive loads and 1/3 hp at 115v ac, speeds of 1 rpm to 1 revolution in 8 days are available. Faster speeds can be obtained with lower switch ratings. The switches are open blade type, either single-pole, single-throw, or single-pole, double-throw. Three-level cams and a neutral position in the single-pole, double-throw switches can be supplied to permit control of up to eight load circuits with a four-pole timer.

The timer operates continuously as long as power is supplied to the high-torque Cramer motor. Wiring terminals are the quick-disconnect spade type. The timer is available for operation on all standard voltages, 50 and 60-cycle frequencies. **Cramer Controls Corp.**, Centerbrook, Conn.

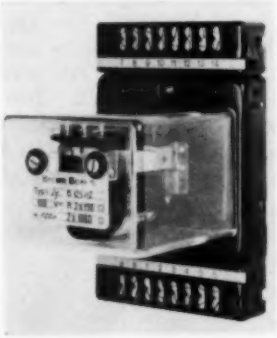
Circle 474 on Inquiry Card

Proximity Control

Designed for use with control circuits, electrical machinery batch counters and electromechanical counters, highly sensitive proximity transducer control unit permits use of conventional electrical plugs at the output. Known as Model 4951, the unit features a receptacle which is wired for 115v ac through an internal relay. The 115v ac is produced at the output when metal is detected by its metal sensing pickup.

Control unit is equipped with a fast single-pole double-throw mercury contact relay which gives the unit a top limit of 3600 operations per minute. Device works on a principle similar to a military mine detector, and is used to operate switches or drive electronic devices. High frequency, carrier operated proximity transducers for general applications and a hollow coil transducer for chute applications are available with the unit. **Electro Products Laboratories Inc.**, 4500 N. Ravenswood Ave., Chicago 40, Ill.

Circle 475 on Inquiry Card



DC Contactor

Developed to improve the performance of many types of automation equipment, high speed dc contactor has a pickup time of approximately 0.1-cycle. Known as Type F, the contactor's speed is rated at 1.8 milliseconds. The unit is well suited for applications in the control circuitry of breakers.

The dc unit is furnished with either four normally open or normally closed contacts, or two normally closed and two normally open contacts. The contacts have a sustained current rating of 5 amp; their making current is 20 amp. The contactor is designed for continuous duty; continuous power is 4w; maximum inrush power is 10w. The breaking current is: At 125v dc, 0.45 amp resistive or 0.35 amp inductive; at 250v dc, 0.35 amp resistive or 0.20 amp inductive. **Brown Boveri Corp.**, 19 Rector St., New York 6, N.Y.

Circle 476 on Inquiry Card

Loading Stations

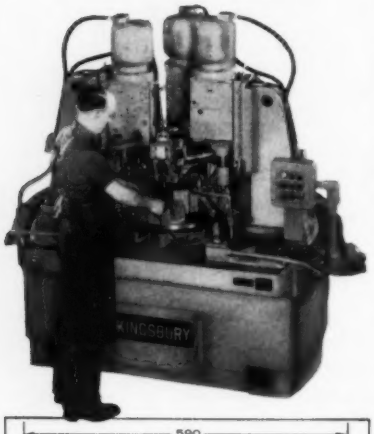
Bumpless transfer from automatic to manual positions or vice-versa without process disturbance or upset is afforded by line of automanual pneumatic control loading stations. The units are adaptable for any pneumatic process control system, and can be used as components in combustion, feedwater regulation, pressure reduction and desuperheating control systems.

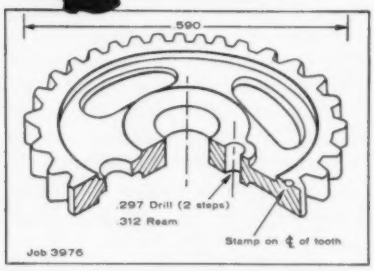
Transfer is a simple matter of matching gage pointers and turning an adjustment knob. The design permits omitting one control station normally used in many cascade control circuits. Pressure range is 3 to 15 psig, with pressure gages scaled from zero to 100 per cent. Both standard and miniature devices are available. The miniature stations can be grouped into a more compact area where space is limited. Stations are available for functions such as loading and transfer, selector biasing, ratio, remote set-auto manual, cascade-auto manual, cascade-biasing, cascade-ratio, manual loading and bias loading. **Copes Vulcan Div., Blaw-Knox Co.**, 939 W. 26th St., Erie, Pa.

Circle 477 on Inquiry Card

450 PER HOUR GROSS

- drilled
- reamed
- stamped





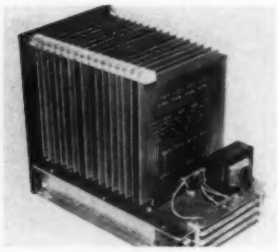
The operator merely loads and unloads this Kingsbury. The stamping device operates at his station. Two automatic units drill and one unit automatically reams. Drilling in two steps shortens the time cycle and increases production.

Kingsbury indexing automatics save money on simple jobs like this and on large complex jobs, too. Machines are all tooled, ready to produce. We invite your inquiry. Kingsbury Machine Tool Corporation, Keene, N. H.

KINGSBURY

INDEXING AUTOMATICS for high production drilling and tapping

Circle 633 on Inquiry Card

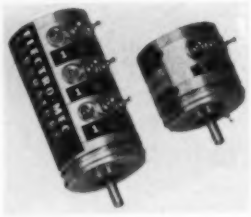


Digital Servocontrol

Used in positioning cross feeds, carriages, saddles and turrets in response to punched card or tape instructions, digital comparator is designed for digital servocontrol systems. The device is also applicable in automatic production of noncircular gears, in controlling the position of squeeze-down rolls on continuous strip mills, and in positioning automatic assembly machinery in accordance with programmed instructions.

The comparator makes possible digital control without using counting techniques. In conjunction with Norden-Ketay's 13 or 19-bit shaft position to digital converter, the digital comparator can provide digital control through conventional servoamplifiers and motors, making possible the application of digital control to existing servosystems with a minimum of change in components. **Norden-Ketay Corp.,** Commerce Rd., Stamford, Conn.

Circle 478 on Inquiry Card



Potentiometer

Designed for computer applications, Type 11 low torque potentiometer features a synchro type mounting. The device is 1.062-inches in diameter and is dimensionally interchangeable with other servocomponents, motors and resolvers. The single and three-gang potentiometers are 0.81 and 1.81-inches long respectively. Individual potentiometer cup are 0.500-inch long and ganged assemblies up to a dozen cups are available. The metal case provides mechanical preciseness and stability, essential for electrical accuracy of the toroidal resistor element.

The potentiometer is available with any resistance value up to 105,000 ohms, and is rated at 1 w at 80C. The toroidal resistor element provides for any electrical rotation angle up to 360 degrees. Nonlinear functional output types are available to meet the requirements of varying applications. **Engineering Dept., Electro-Mec Laboratory,** 47-51 33rd St., Long Island City 1, N.Y.

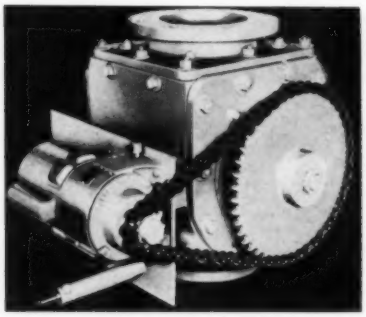
Circle 479 on Inquiry Card

Temperature Control

Designed for fast acting precision control of critical temperatures necessary in processing operations, Model HL 15-10 high-temperature limit control acts to cut off the heat supply if a predetermined temperature, set on the calibrated scale, is exceeded. The limit control protects against loss or damage to equipment or work being processed which might result from overheating.

Bulb temperature is indicated on the calibrated scale at all times. Not only does the instrument provide a second check on process temperature, but the indicating feature gives visual proof that the control is in operating condition, and ready to shut down the process should safe operating temperature be exceeded. Once the temperature has risen to the predetermined set point, the circuit cannot be reestablished until the manual reset button has been pressed. **Partlow Corp.,** New Hartford, N. Y.

Circle 480 on Inquiry Card

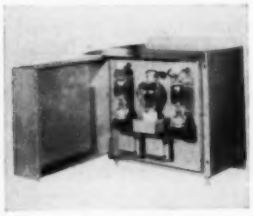


Rotary Feeder

Designed to handle free flowing granulated solids, Type B rotary feeder features accurate feed control and positive shut-off. A measured flow of material results from a rotor and shoe design that permits only a specific amount of material to fall into each pocket. Excess material cannot bypass the rotor.

The shoe is a cylindrical arc that contacts the periphery of the rotor blades and spans three rotor pockets. In addition to controlling the material feed, the shoe also insures positive shut-off. The seal of the shoe with the rotor blades is maintained by adjusting the relative positions of both shoe and rotor. As the loaded pockets rotate away from the closure of the shoe, material falls unrestricted through the space between the circumference of the rotor and the side of the housing. Feeders are available in five sizes for attaching to 4, 6, 8, 10, or 12-inch diameter pipe flanges. **Allen-Sherman-Hoff Co.**, 259 E. Lancaster Ave., Wynnewood, Pa.

Circle 481 on Inquiry Card



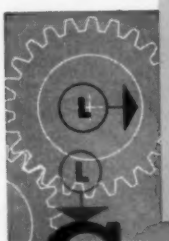
Adjustable Speed Drive

Used in production operations such as continuous processing, batching, feeding, conveying, testing, pumping, etc., electronic adjustable speed dc drive aids in in-

If it's hard to hold...

call Garrison

We designed and built the world's first automated gear chucks. These were successful immediately. Repeat orders, and production records covering millions of gears in high-production and contract gear plants alike, firmly established our reputation as the firm to see first on all jobs. This experience can be yours without cost or obligation. So—the moment the matter of automation arises—call on us. Let us engineer and build the quick-acting, trouble-free, accurate workholding fixtures which determine to some considerable extent the *output* and *quality* of parts that will be produced on your proposed automated machines.



If you are not ready for the plunge into automation . . . we can furnish special holding fixtures for your standard machines that will help match the efficiency and production capacities of automated equipment. Send your prints. No obligation, of course.

GARRISON MACHINE WORKS, INC.

DAYTON 4, OHIO, U.S.A.

Circle 636 on Inquiry Card

you can
DIAL your
ADJUSTMENT
on this
AGASTAT®
time/delay/relay

Frequent time adjustments are no problem with the dial head available on AGASTAT time/delay/relays. They provide a complete range of adjustment with 1 revolution of the dial. Dial markings permit easy calibration for accurate adjustment. And you can spot each of the 4 timing ranges quickly because they are color coded: blue from 30 seconds to 15 minutes; red from 10 seconds to 2 minutes; yellow from 0.1 to 10 seconds; white from 0.1 to 3 seconds.

Like all AGASTAT relays, units with dial heads are solenoid actuated, pneumatically timed. Each model is available with either dial head or needle valve adjustment. Where frequent readjustment of timing is necessary, dial head adjustment should be specified. For bulletin on all popular AGASTAT time delay relays, write to: Dept. A28-523

AGA DIVISION

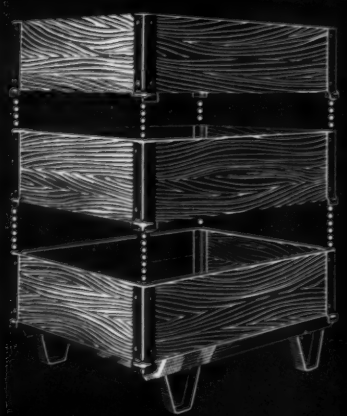
Elastic Stop Nut Corporation of America

1027 Newark Avenue, Elizabeth, New Jersey
Pioneers in pneumatic timing

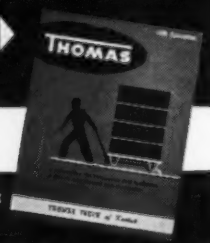
Circle 634 on Inquiry Card

THOMAS SKID PLATFORMS

SECTIONAL BINS
SKID BOXES
and ACCESSORIES
meet your
exact needs



WRITE FOR
CATALOG NO. SAP-56



THOMAS TRUCK & CASTER CO.
713 Mississippi River • Keokuk, Iowa

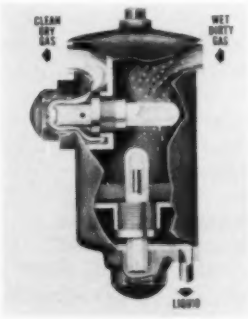
THOMAS MAKES ALL KINDS OF TRUCKS, SKIDS, CASTERS AND WHEELS

Circle 635 on Inquiry Card

creasing production. Designed to give close speed regulation and to meet minimum space requirements, the drives are available in five sizes ranging from ¾ through 3 hp. They provide electronic control of dc motors from ac power. Speed range is 50 to 1, with any speed from 35 to 1750 rpm.

No tachometer is required for any size unit since the drive motor is also used as a tachometer. The drives are available as complete packages, consisting of an anode transformer, a control panel, a control station, and a dc shunt wound drive motor. **Weltronic Co.**, 19500 W. Eight Mile Rd., Detroit 19, Mich.

Circle 482 on Inquiry Card



Liquid-Gas Separator

Developed to provide clean, dry air for operating pneumatic equipment and control and recording instruments, Liqui-Jector is a liquid-gas separation device for removal of entrained liquids and solids from air, gas and steam systems. The device is available in 12 standard sizes. The unit operates by phase separation, trapping solids and passing liquid in one direction and gas in another, without interrupting the flow through the line. In addition to air and steam, such gases as hydrogen, oxygen, nitrogen, argon, propane, butane, and generated atmospheres can be cleaned and dried.

Liqui-Jectors are available in three standard models: Series A for volumes up to 100 scfm gas at 150 psig; Series B for volumes up to 7000 scfm gas at 200 psig; and Series C for conditions where unusually large volumes of condensate are encountered. **Selas Corp of America**, Dresher, Pa.

Circle 483 on Inquiry Card

BROADENS HORIZONS at **BELL**

Bell Aircraft is an organization in which the successful culmination of important projects has meant continual, sound expansion through the years. This growth, together with Bell's widely diversified fields of interest, offer exceptional opportunities for engineers and technicians as listed at the right—opportunities with horizons as broad as the universe and professional growth limited only by your own personal abilities. You'll never be slowed down by the lack or limited scope of projects at Bell.

For further information regarding employment opportunities in the Weapon Systems Division or the Aircraft Division of Bell Aircraft, write today: Manager, Technical Employment, Dept. C21, Weapon Systems Division.

BELL AIRCRAFT CORPORATION, P. O. Box One, Buffalo 5, New York.

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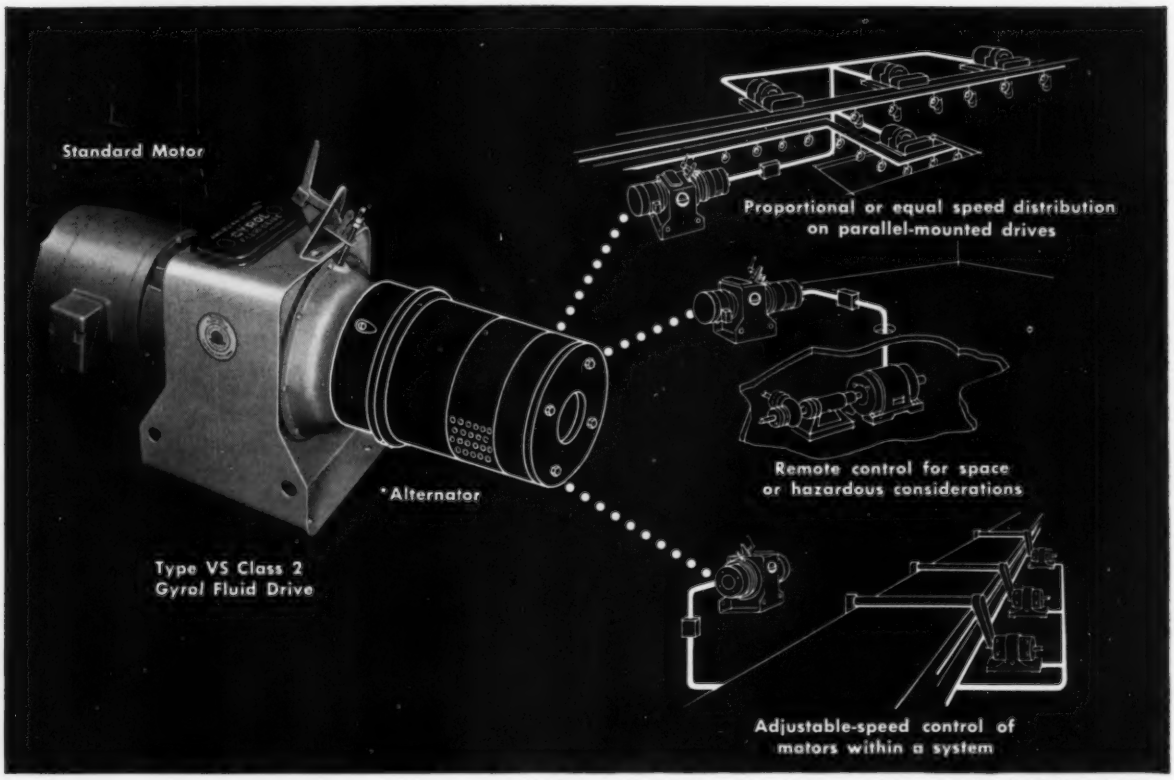
- Dynamic Engineers
- Electronic Engineers
- Electronic Standards Engineers
- Engineering Computors
- Environmental Specialists
- Field Test Engineers
- Flight Test Engineers
- Flight Test Programmers
- Fuel Injection Specialists
- Gear Designers
- Guidance Engineers
- Gyro Specialists
- Heat Transfer Engineers
- Hydraulic Engineers
- IBM Programmers
- Instrumentation Specialists
- Laboratory Test Engineers
- Magnetic Amplifier Specialists
- Mathematical Analysts
- Mechanical Engineers
- Microwave Engineers
- Miniturization Engineers
- Nuclear Physicists
- Operations Analysts
- Physicists
- Power Plant Designers
- Pressure Vessel Designers
- Project Engineers
- Publication Engineers
- Radar Systems Engineers
- Reactor Designers
- Reliability Engineers
- Rocket Test Engineers
- Servo Systems Engineers
- Servo Valve Engineers
- Statisticians
- Stress Engineers
- Structures Engineers
- Specification Writers
- Technical Writers
- Test Equipment Engineers
- Transformer Design Specialists
- Transistor Application Engineers
- Thermodynamic Engineers
- Telemetering Engineers
- Turbine Pump Designers
- Vibration & Flutter Analysts
- Weapons Systems Engineers
- Wave Guide Development Engineers
- Weights Engineers

Circle 637 on Inquiry Card

AMERICAN BLOWER *Gýrol* FLUID DRIVE


Standard Motor
Proportional or equal speed distribution on parallel-mounted drives
Remote control for space or hazardous considerations
*Alternator
Type VS Class 2 Gyrol Fluid Drive
Adjustable-speed control of motors within a system

*Output adapter, flexible coupling and alternator furnished by others.

Matched, adjustable-speed control of AC induction motors lets you control speeds in coordinated production processes

Here's how it works: an alternator, driven through an adjustable-speed Gýrol Fluid Drive, makes variable frequency available from a fixed-frequency power source. Motor speeds are controlled by merely regulating the Gýrol Fluid Drive.

The Gýrol Fluid Drive method is a simplified system for controlling the speed of driven machinery. For example:

- On parallel-powered drives, the constant-speed motors are given coordinated speed adjustment thru the frequency control created by the adjustable-speed Gýrol Fluid Drive.
- The speed of two or more machines or conveyors may be controlled equally or proportionally by a single Gýrol unit coupled with an alternator.
- The Gýrol Fluid Drive's speed control enables you to adjust speeds manually, semi-automatically or automatically at a remote station.

For full information on how you can adapt Gýrol Fluid Drives to your specific requirements, call our nearest branch office.

American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

AMERICAN BLOWER

Division of AMERICAN-Standard

catalogs and literature

Latest automation information. For copies use card page 17.

Machining Units

Rehnberg-Jacobson Mfg. Co., 2135 *Kishwaukee St., Rockford, Ill.*—45-*page catalog*—Self-contained drill units, tape units and index tables are described in catalog. Variety of machines using the standard elements and special equipment for drilling, reaming, tapping, facing, serrating, pin inserting, countersinking, etc. are illustrated and described. Photographs, dimensioned sketches, wiring diagrams, and specifications for the standard units are included.

Circle 484 on Inquiry Card

Lock Nuts

MacLean-Fogg Lock Nut Co., 5535 *N. Wolcott Ave., Chicago* 40, *Ill.*—12-*page bulletin*—Developed to maintain the original design of a product in manufacture and the original inspection standards of a product in use, line of lock nuts is described in bulletin. Types covered include two models of prevailing torque types, and two models of free spinning square or hexagon nuts. Two-way lock nut model of prevailing torque type is described as especially suited for automated assembly operations since both sides are the same and orientation for proper side is not required. Tables also show available types of American Standard nuts.

Circle 485 on Inquiry Card

Pushbutton Control Units

Cutler-Hammer Inc., 378 *N.* 12*th St., Milwaukee, Wis.*—30-*page catalog*—Line of pushbuttons, indicating lights, selector switches, and accessories is described in catalog. Fold-out pages illustrate all available models in line, showing them in actual colors. Two new pushbutton units the Pres-Test and Roto-Push, are included. Specifications and comprehensive selection data are given.

Circle 486 on Inquiry Card

Automatic Copying Lathe

Pilot Div., Cone Automatic Machine Co. Inc., 30 *Rockefeller Plaza, New York* 30, *N.Y.*—6-*page pamphlet*—Designed to perform a number of operations or cycles in accordance with the synchronized movements of its tool carriages and automatically positioned pilot templates, automatic copying lathe is the subject of illustrated bulletin. Photographs show the lathe equipped with one and two vertical tool slides; pictures are also used to illustrate the accuracy, rigidity, speed and safety features of the lathe.

Circle 487 on Inquiry Card

Numerical Positioning Table

Jones & Lamson Machine Co., Springfield, Vt.—6-*page pamphlet*—Reduction of work inventory and long production lead time, and elimination of drill jigs are features of drill press equipped with numerically controlled positioning table which is described and illustrated in pamphlet. Information on the method of operation and tape preparation is given; photographs of table equipped drill press and the specifications are also included.

Circle 488 on Inquiry Card

Automation Service

Lester B. Knight & Associates Inc., 549 *W. Randolph St., Chicago* 6, *Ill.*—4-*page pamphlet*—Brief description of company policy in performing services in automation, materials handling, mechanization, modernization, construction management, and plant architectural engineering is given in Bulletin 102. Photographs illustrate company engineered systems and plants.

Circle 489 on Inquiry Card

Photoelectric Cells

Photoconductor - Transistor Div., Electronics Corp. of America, One Memorial Dr., Cambridge 42, *Mass.*—8-*page bulletin*—Infrared sensitive lead sulfide photo-conductors for detection and guidance systems are the subject of Bulletin TR-101. Photographs of the cells, specifications for four general cell types, and graphs for cell response as a function of both wavelength and source temperature are shown.

Circle 490 on Inquiry Card

Bottling & Processing Units

Barry-Wehmiller Machinery Co., 4660 *W. Florissant Ave., St. Louis* 15, *Mo.* — 109-*page catalog* — Equipment for uncasing, cleaning, pasteurizing, labeling, and inspecting bottles is described and illustrated in collection of bulletins which comprise catalog. Systems for conveying, filing and feeding bottles are also discussed. Application photographs, specifications, principles of operation, plant layout data and dimensioned sketches are included.

Circle 491 on Inquiry Card

Tray Conveyor Units

J. W. Greer Co., Wilmington, Mass. —8-*page bulletin*—Used for cooling, heating, freezing or drying processes, Multi-Tier conveyor which is described in bulletin makes possible conversion from batch methods to continuous processing. Efficient storage of product in process, keeping of product level at all times, automatic loading and unloading are features of the conveyor units. Bulletin includes several application photographs and pictures of products processed on the conveyor.

Circle 492 on Inquiry Card

Lubrication Systems

Bijur Lubricating Corp., 151 *W. Passaic St., Rochelle Park, N.J.*—12-*page bulletin*—Automatic metered lubrication is provided to each bearing of a machine by distribution systems described in Bulletin 4A. Reservoirs, tubing, fittings, junctions and meter units are discussed. Procedure for analysis of oil distribution, determination of fittings of the system, and installation details are included.

Circle 493 on Inquiry Card

Air Control Valves

Nopak Div., Galland Henning, 2734*A S.* 31*st St., Milwaukee* 46, *Wis.* —16-*page booklet*—Line of Nopakmatic, pilot operated, poppet-type air control valves is described in Catalog No. 105. Valves are available for two, three and four-way operation and feature interchangeable Flow Di-

rector pilot heads which automatically take pilot pressure from the pressure supply port of the valve regardless of piping arrangement. Dimensions, installation data, application information and operating characteristics are given.

Circle 494 on Inquiry Card

Stop Nuts

Greer Stop Nut Co., 2620 *Fluornoy St., Chicago* 12, *Ill.*—36-*page catalog*—Complete line of stop nuts, including hexagon, clinch, spline and intrument mounting types, is illustrated and described in catalog. Thread size, class fit, width, height, weight, list price and catalog number are given for available types.

Circle 495 on Inquiry Card

Thermal Conductivity Analyzer

Hays Corp., Michigan City, Ind.—12-*page bulletin*—Electronic operation and the thermal conductivity principle of gas analysis are combined in the Condu-Therm thermal conductivity analyzer which is described in Bulletin 56-1008-59. Also covered is a thermal conductivity recorder which consists of an analyzing section electrically connected to a remote recording section. Photographs and sketches of gas sampling systems illustrate the equipment.

Circle 496 on Inquiry Card

Precalibrated Thermostats

Franklin Dales Co., 180-184 *E. Mill St., Akron, O.*—8-*page bulletin*—Used for automatically making and breaking circuits, on motors, cycling systems, etc., Temp-Guard thermostats are discussed in bulletin. Photographs and specifications of standard models in the line are included.

Circle 497 on Inquiry Card

Inductive Devices

Freed Transformer Co. Inc., 1705 *Weirfield St., Brooklyn* 27, *N.Y.*—48-*page catalog*—Transformers, filters, discriminators, toroidal inductors, magnetic amplifiers and ultrasonic components are included in line of electronic components which is described and illustrated in Catalog No. 571. Devices are available open, hermetically sealed or encapsulated. Units are offered for commercial and military uses. Photographs, specifications and performance curves are included in the catalog.

Circle 498 on Inquiry Card

Lubricating Sleeve Bearings

Fluidwick Co., 5319 *E. Outer Dr., Detroit* 34, *Mich.*—8-*page bulletin*—Used in such products as electric motors, generators, pumps, fans, blowers, etc., Permawick makes possible high speed wicking and oiling of sleeve bearings in a single automatic operation. Illustrated bulletin describes the principles leading to the development of Permawick; photograph of Permajector machine for automatically injecting the material is included. Application pictures with brief description of results of using Permawick complete the bulletin.

Circle 499 on Inquiry Card

Feeding Flowable Materials

Hapman Conveyors Div., Hapman-Dutton Co., 19209 *W. Davison, Detroit* 23, *Mich.*—4-*page pamphlet*—Enclosed in tubular casings, circular flight conveyors which are designed for the continuous feeding and processing of flowable materials into or out of zones under pressure or vacuum are described and illustrated in pamphlet. Cutaway photograph shows Pneumatrol, the sealing device which prevents leakage into and out of pressure or vacuum zones.

Circle 500 on Inquiry Card

High Pressure Pumps

Tuthill Pump Co., 939 *E. 95th St., Chicago* 19, *Ill.*—8-*page bulletin*—Rotary, internal gear positive displacement pumps which operate on pressures up to 400 psi are described in Catalog No. 103. Built in capacities from 5 to 200 gpm, the Model CK pump is used for hydraulic, coolant, transfer and circulating service. Tables and diagrams give operating data, dimensions and parts of the basic pump and its variations.

Circle 501 on Inquiry Card

Builders for Automation

Cummings Machine Works, 9-11 *Melcher St., Boston, Mass.*—14-*page bulletin*—Automatic feeder systems and special machines are included in equipment described and illustrated in bulletin. Photographs illustrate several feeders designed for special applications; variety of parts handled by these machines is shown. Automatic transfer machines to position, drill, tap, bore, ream, mill clean and eject a casting are among the special machines mentioned.

Circle 502 on Inquiry Card

Low Speed Drives

Boston Gear Works, Quincy 71, *Mass.* — 8-*page bulletin* — Series 100 Reductors, flanged Reductors and Ratiomotors are described in bulletin on speed conversion equipment. Reductors feature speed conversion with a low transmission loss. Ratiomotors include a gear reduction unit and a detachable end-mounted motor. Photographs and certified ratings of all models in the line are included.

Circle 503 on Inquiry Card

Adjustable Autotransformers

General Radio Co., 275 *Massachusetts Ave., Cambridge* 39, *Mass.*—24-*page catalog*—Featuring an output voltage which is continuously adjustable from 0 to 117 per cent of line by approximately 320-degree rotation of the knob, Variac continuously adjustable autotransformer is the subject of illustrated catalog. Autotransformers are available in single unit and ganged assemblies. Numerous models are pictured and their specifications are presented in chart form.

Circle 504 on Inquiry Card

Production Engineering Service

Engineering Service Inc. of America, 21460 *W. Eight Mile Rd., Detroit* 19, *Mich.*—8-*page bulletin*—Offering services in production engineering, producibility study, manufacturing cost analysis and equipment design in metalworking and other industrial fields, company describes its general services in illustrated bulletin. Experience in designing special automated machines includes both multiple-station and transfer type machine tools as well as sheet metal equipment.

Circle 505 on Inquiry Card

Welding Equipment

Raytheon Mfg. Co., Waltham 54, *Mass.*—16-*page booklet*—Used in the production of vacuum tubes, capacitors, meters, relays, timing mechanisms and numerous other small parts and assemblies, line of automatic resistance welding equipment and components is discussed in Bulletin 2-100. Welding heads, controls, dc and ac power supplies, and welding electrodes are illustrated and described. Photographs, specifications and a glossary of welding terms are included.

Circle 506 on Inquiry Card

Control Instruments

Consolidated Electrodynamics Corp., 300 *N. Sierra Madre Villa, Pasadena, Calif.*—32-*page catalog*—Instruments for analysis, control and data processing are described and illustrated in catalog. Oscillographs, amplifiers, vibration measuring equipment, pressure measuring equipment, mass spectrometers, digital data processing and process control instruments are discussed. Numerous photographs illustrate the catalog.

Circle 507 on Inquiry Card

Conveyor & Pusher Furnaces

G. I. Hayes Inc., 800 *Wellington Ave., Cranston* 10, *R. I.*—8 *looseleaf pages of data*—Motor driven belt furnaces, with a maximum temperature of 2100F, and pusher type furnaces

for progressive batch heat treatment of materials from 1600 to 2400F are described in Bulletins 464 and 463 respectively. Several models of each type are covered, with specifications and photographs included.

Circle 508 on Inquiry Card

Automatic Feeders

Arlin Products Inc., 13541 *Auburn Ave., Detroit* 23, *Mich.*—20-*page booklet*—Designed to convert manual or semimanual machines to fully automatic, high speed production units, line of electronically controlled automatic feeders is the subject of Catalog No. 102-B. Operating characteristics, specifications and photographs of eight models are included. Also shown are hopper applications, inspection units and other feeding equipment.

Circle 509 on Inquiry Card

Solderless Connections

Keller Tool Div., Gardner-Denver Co., Grand Haven, Mich.—12-*page bulletin*—Wire-wrap connections, each of which consists of a wire wrapped around a terminal so tightly that it meets the basic requirements for a permanent solderless connection, are the subject of illustrated bulletin. Discussions on the development of the method, size relationships and advantages are included. A tool for making the electrical connections is also illustrated and described.

Circle 510 on Inquiry Card

High-Speed Analog Computers

GPS Instrument Co. Inc., 811 *Boylston St., Boston* 16, *Mass.*—8-*page bulletin*—Written in question-and-answer style, illustrated bulletin answers questions from engineers, executives and educators who are interested in the use of computers for the development of control systems. Advantages and limitations of high-speed analog computers as compared with real-time computers are discussed. Linear and nonlinear components for computing are illustrated and briefly described.

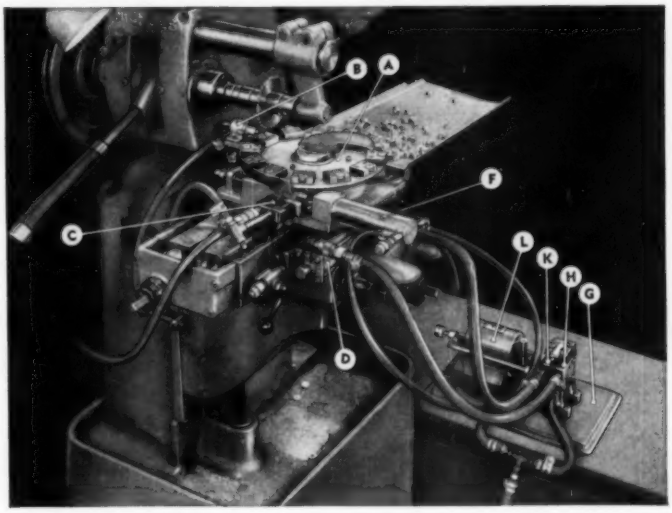
Circle 511 on Inquiry Card

Petroleum Engineering Service

Gulf Oil Corp., 1822 *Gulf Bldg., Pittsburgh* 30, *Pa.*—24-*page catalog*—Petro-engineering Service is the name given to problem-solving assistance offered by Gulf. The service is designed to provide information on any problem or process involving fuels, lubricants, or other products of petroleum. Catalog illustrates applications of the service in such problems as lubricant storage and dispensing, machining, heat treating, rust prevention, etc.

Circle 512 on Inquiry Card

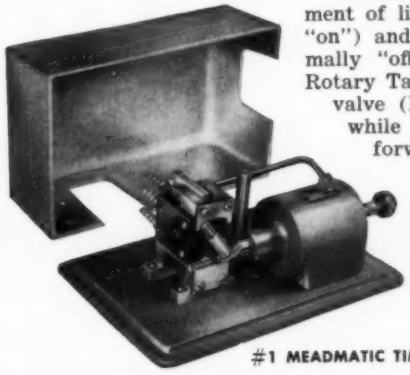
Automation with Air Power



Five standard Mead units converted this hand milling machine into a semi-automatic machine to mill a slot in threaded brass valve plugs, increasing the production from about 375 per hour to more than 1200.

The mill table is moved forward and back by an air cylinder with 1½" bore and 5" stroke, and during each cycle the Rotary Table discards the finished part and indexes a new part to the work station. The Meadmatic Timer is the "brains" of this hookup, delivering air at the right instant to the feed cylinder (D) and consequently to the Rotary Table, (A) and the work-holding cylinder (B). The problem was how to synchronize the motions so that the dial of the rotary table would not rotate while the work was passing under the cutter.

The solution was in the arrangement of limit valve (F), (normally "on") and auxiliary valve (C) normally "off", which keep both the Rotary Table and the work holding valve (B) in the locked position while the mill table moves forward and back; but when the mill table returns to its starting point (A) and (B) are momentarily released to index to the next station.



#1 MEADMATIC TIMER

Write to Factory or Nearest Mead Representative for Bulletin A-57.

See Alphabetical index Thomas' Register for nearest Mead Man Address or Phone Number.

MEAD

SPECIALTIES COMPANY

4114 N. Knox Ave., Dept. A-57, Chicago 41, Illinois

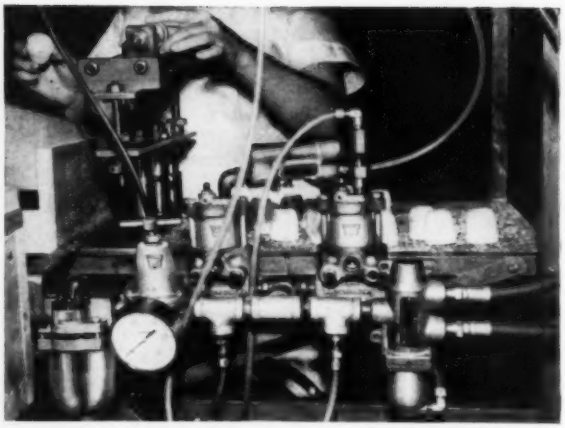
Pathfinder in AIR POWER AUTOMATION

Circle 639 on Inquiry Card

***Progress** in designing air systems:*

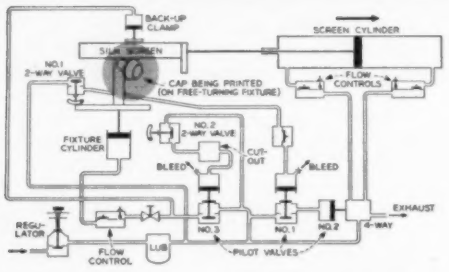
Here's an automating idea: Schrader Air Products in a precision programming operation

PROBLEM: To print bottle caps accurately at high speed.

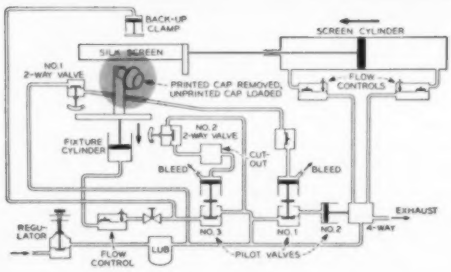


PROVED IN OPERATION: Prominent silk screen printer puts Schrader products to work at a profit.

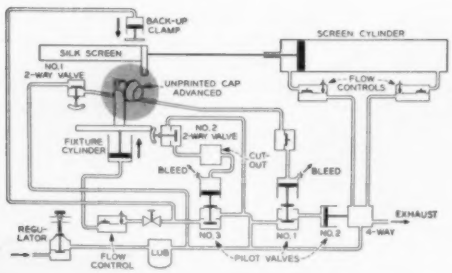
SOLUTION: Adapt Schrader Air Products to silk screen printer.



1 Fixture holding plastic cap on freely rotating fixture is held up against silk screen by Schrader cylinder. Another Schrader cylinder pushes screen sideways over the freely rotating cap, imparting the printed message.



2 Fixture with printed cap moves down, back-up clamp retracts and screen cylinder returns to initial position. Operator removes printed cap and loads another unimprinted cap.



3 Schrader cylinder advances fixture upward loaded with unimprinted plastic cap. Back-up clamp starts downward toward silk screen. And cycle starts all over again.

This is but one precision operation of the limitless operations which can be controlled *fast, economically* and *accurately* by Schrader Air Products. The hundreds of different units in Schrader's complete line can be employed alone or in combination to perform stamping, programming, forming, measuring, squeezing—other jobs too! And wherever air is used, economy is basic.

Test the performance of all your machines against the efficiency that could be achieved with air. Schrader engineering facilities are available to help you. Outline your problem to us and assistance will be prompt. Right now, mail the coupon.

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a division of **SCOVILL**
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AUTOMATION abstracts

RECEIVING AND SHIPPING CONTROL

By A. T. GAUDREAU
Gaudreau, Rimbach & Associates
Pittsburgh, Pa.

THE FINAL PHASE of processing beer; namely, bottling and packing, marks the starting point of case-handling operations within a brewery. To this point in beer processing, the beer has been handled as a bulk liquid which has now reached the storage tanks ready for the fillers in the bottle house. Here the entire complexion of material handling changes from bulk handling to package handling.

The complete route of cases may be divided into two successive flows pivoting on the bottle house. The first is the route of empties from inbound carriers to bottle house; the second is the return flow of filled cases from bottle house to outbound carriers. Storage areas are maintained for both flows to equalize the feeding of empties into the bottling lines, and the loading of fulls on the shipping docks.

In a one-product plant, such as a dairy, these two flows can conceivably be linked at the bottling machines to form a single, continuous parade of cases from inbound carriers, through bottling and packaging operations, and back into outbound carriers. Even in such a comparatively simple round-trip routing, the carriers and the bottling machines could only work in unison so long as they worked simultaneously; otherwise an inventory would have to be maintained for empties on the intake flow and for fulls on the outgo from production lines.

At the Jackson Brewery in New Orleans, La., however, the round-trip journey of cases from receiving, through bottling, and back into shipping encounters many interruptions and unbalanced side trips not present in the foregoing ideal run-through route such as in a dairy establishment. Yet, in setting up the case-handling modernization plan at this brewery, the run-through principle was made a primary objective wherever it could be developed in the handling of both the empties and the fulls. This called for a considerable amount of adjustment and reconciliation in the timing of production runs of specific case goods to coincide with the time and quantity of the loading of these identical products in box cars, reefers and trailers.

To keep the bottle lines and can lines running directly into outbound carriers, without having to resort to storage areas for absorbing overruns or supplying shortages, became the main objective in planning production and shipments. After several months of trial and error, this synchronized flow was attained for all but a few small-quantity, odd-lot items, mostly in the tax beer category. How production runs were synchronized with shipping operations to permit palletized loads of filled cases to be routed from these runs directly into outbound carriers, without flooring the output or dipping into finished storage, will now be examined.

The business of the brewery, it will be recalled, is about evenly divided between rail shipments and truck shipments. This division offered a convenient alternative between rail cars and trailers in routing production runs of specific products directly into outbound carriers. Since empty rail cars could be loaded at will within a given day, it was comparatively simple to direct production runs

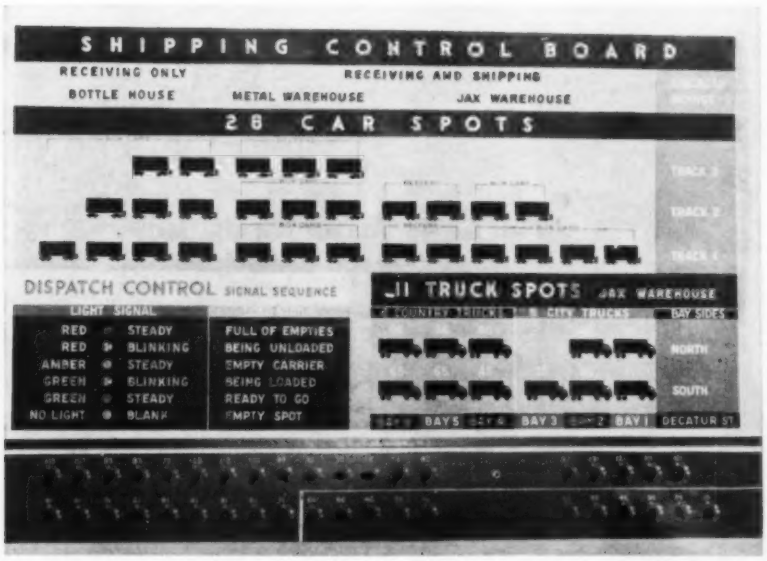


Fig. 1—Dispatcher's pushbutton control board showing loading-unloading and full-empty status of truck and rail carriers.

Are your chances against cancer any better today?

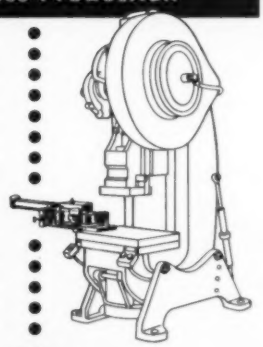
The answer's yes . . . IF!

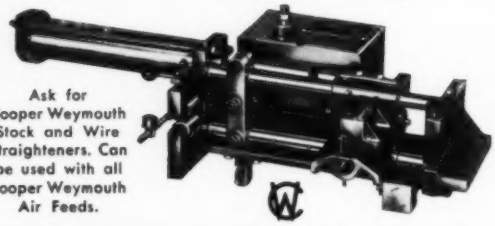
Formerly, we could cure one out of every 4 cancer patients. Today, it's one out of 3. So . . . why the big IF? Because the odds against cancer depend on you! Only *you* can keep alert for any of the 7 danger signals, and see your doctor about even the tiniest "maybe." Only *you* can give us the money we need to keep research going full speed. Remember, time is *everything* with cancer. So don't wait! See your doctor for a health checkup. And send a check to the American Cancer Society–today! Send your gift to "Cancer" in care of your local Post Office.

American Cancer Society

COOPER WEYMOUTH
AIR OPERATED SLIDE FEEDS
Boost Power Press Production

Specifically designed to solve the automatic feeding problems in press rooms. Simplified, open throat construction. Air operated from standard shop lines. Easily set up and adjusted at the front, rear or sides of press for accurate long or short runs. Cooper Weymouth Air Feeds, made in five sizes, will feed lengths up to 36", of stock up to 18" in width. They are readily adaptable to material of irregular cross section and ideal for use with hydraulic presses.





Ask for Cooper Weymouth Stock and Wire Straighteners. Can be used with all Cooper Weymouth Air Feeds.

SEND FOR INFORMATION ON THESE AND OTHER PRODUCTS

COOPER WEYMOUTH, INC.
600 HONEYSPOT ROAD, STRATFORD, CONN.

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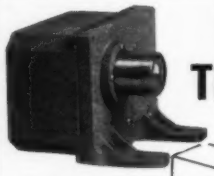
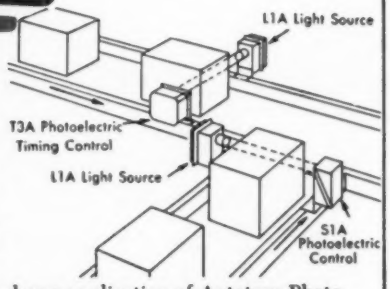


Photoelectric Timing Controls



For conveyor jam-up and traffic control, ramp signals, paint spray control, counting and other applications where timing is needed with photoelectric operation.

The diagram shows application of Autotron Photoelectric Timing Control and Photoelectric Control on converging conveyors to prevent collision or jamming of cartons.

AUTOTRON Photoelectric Timing Controls are available with varied timing arrangements and adjustable timing periods to meet widely varied requirements.

Send for catalog with application diagrams or tell us what you want to do.

The AUTOTRON Co.
P.O. Box 722-RRV, Danville, Ill.

Representatives in principal cities

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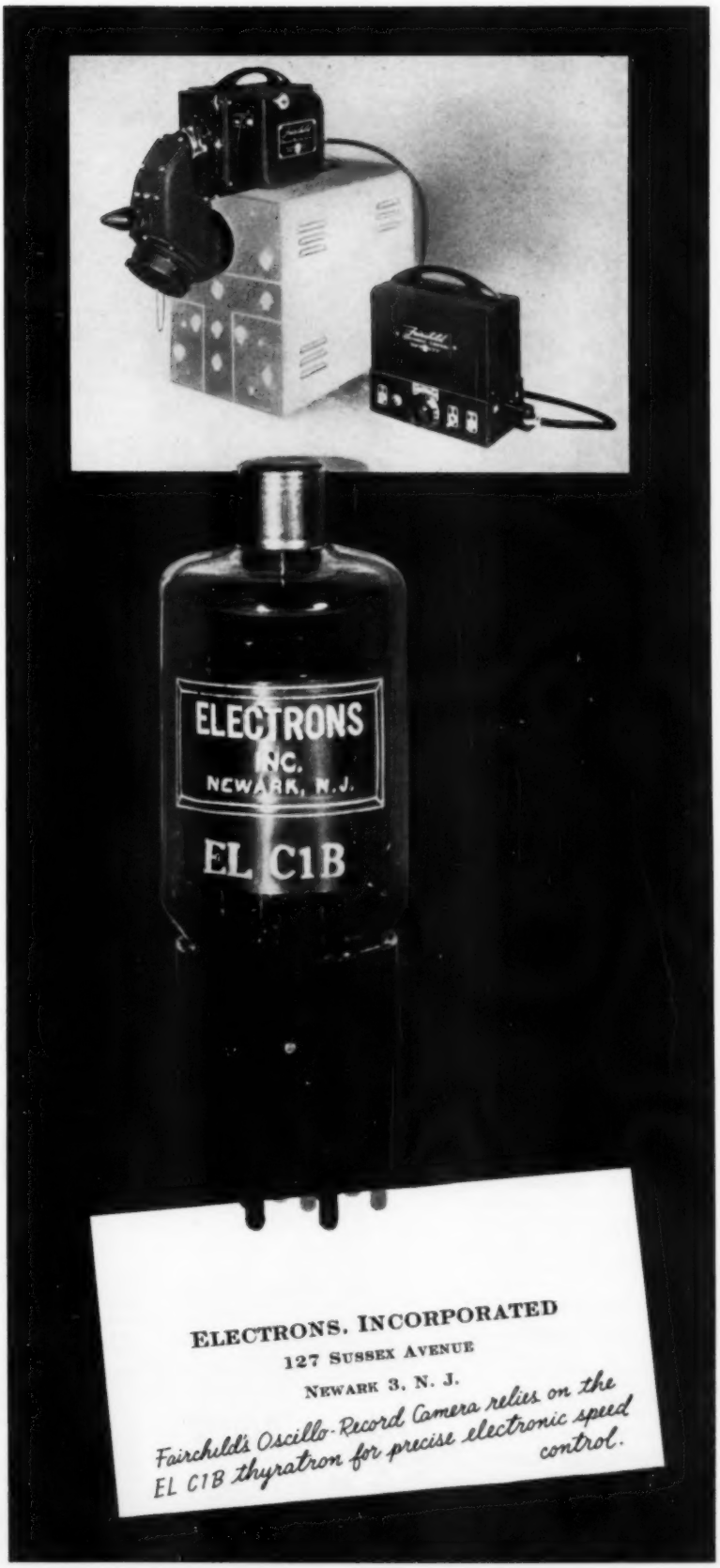
into these scheduled cars whenever scheduled trailers for the same product were not at hand, or failed to show up altogether. Rail car shipments thereby became the balancing medium for absorbing production scheduled for trailers which failed to arrive on a given day, or arrived a day ahead of time.

But bottle-house production for a given day was governed by machine capacity whereas the shipments for the same day were governed by distributors' orders, and these two volumes never coincided in size or composition. So, in order to maintain production on a run-through basis so as to avoid handling fulls in and out of finished storage, it was necessary to reconcile each day's total shipments with each day's total output for each type of product. A "chicken-and-egg" problem arose at this point, however; the question was which came first, production or shipments, in setting up the production schedules for a given week. If shipments exceeded output capacity at the beginning of the week, where would the shortage of products come from except out of finished storage? On the other hand, if production output capacity exceeded shipments at the tail end of the week, where would the surplus output go except into storage to fill excessive shipments at the beginning of the following week?

These two apparently irreconcilable problems in the daily flows of case goods defied solution for weeks and months until rail shipments were brought into the schedules to act as the balancing medium between daily output and daily shipments. It was found that rail cars could be loaded one or two days in advance of scheduled shipping dates without unduly affecting the distributors. Because of the irregularity already existing in car-routing time on the railroads themselves, the advance loading of cars offered the needed cushioning influence without perceptibly affecting railroad delivery time.

Distributors now send in their orders for an entire week a few days in advance of that given week. These orders are immediately summarized for each day by products and by individual carriers. Using these shipping requirements as a basis, plus whatever stock may be



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FULLY AUTOMATIC FORT WAYNE
STATOR WINDER

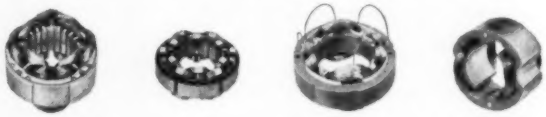
- **Winds Up To 150 Stators Per Hour**
- **Winds 2, 4, 6 and 8-Pole Stators**
- **Stack Heights to 3" max.—Diameters to 6" O.D.**

Two types of machines available:—**Simultaneous type**—capable of winding up to 8 poles at one time. Tap pullers can be added for two and three-speed windings. **Indexing type**—capable of winding series-wound stators or stators for split-phase motors. The single-winding needle setup eliminates all interpole connections. The multi-needle setup decreases the number of interpole connections.

Standard models wind wire from 19-gauge to 36-gauge at speeds ranging from 300 to 600 turns per minute. Heavy-duty models wind wire from 14-gauge to 18-gauge at speeds ranging from 150 to 350 turns per minute.

Automatic lead cut-off serves as lead anchor in starting next stator. One operator can handle multiple machines. Cycle is automatically repetitive.

Write for complete data or, if convenient, arrange to call at our plant where a machine is always available for demonstration.



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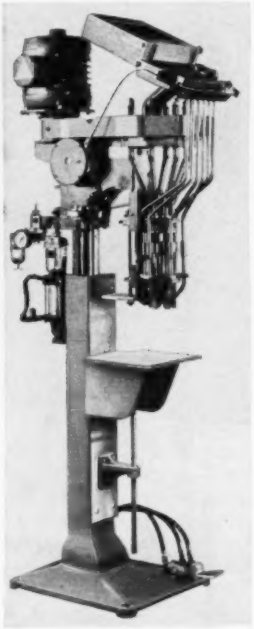
MULTIPLE SPINDLE SCREWDRIVING MACHINES

The use of multiple spindle screwdriving machines is a great advantage on assemblies requiring the driving of two or more screws. Standard machines can be furnished to feed and drive up to 8 screws at a time.

ADVANTAGES OF MULTIPLE DRIVING

Simpler set-ups . . .
Increased production . . .
More uniform driving . . .
Easy to operate . . .
Less handling of parts . . .
Low maintenance costs . . .

Furnish samples and job requirements when writing for quotation.



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Package it up to
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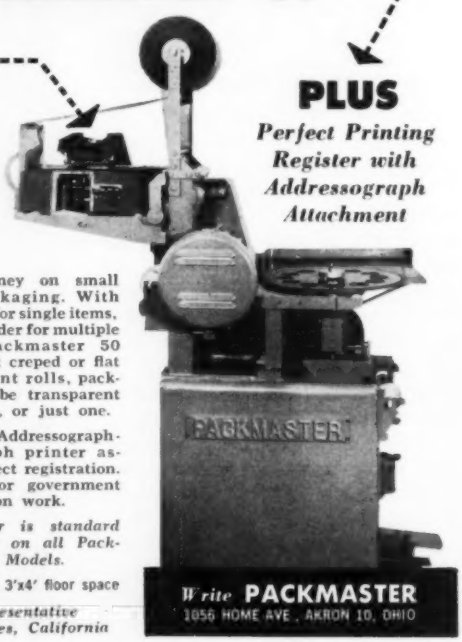
PACKMASTER "50"

PLUS
Perfect Printing Register with Addressograph Attachment

Also Available with MARKEM unit



Saves money on small parts packaging. With turntable for single items, pusher feeder for multiple items, Packmaster 50 takes most creped or flat transparent rolls, packages can be transparent both sides, or just one.

Optional Addressograph-Multigraph printer assures perfect registration. A must for government specification work.

A counter is standard equipment on all Packmaster 50 Models.

Require just 3'x4' floor space

Field Representative
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on hand, a production schedule is set up for each day of the following week. To equalize excessive shipments on certain days with excessive production on others, rail car shipments are advanced or retarded one or two days either way. By adhering to this scheduling process, all car shipments and virtually all trailer shipments are being made on a run-through basis, namely, by trucking palletized loads from the production runs directly into these carriers. The equivalent of less than one-half a day's shipments is maintained in storage, and this is entirely made up of short-run products packaged in advance so as not to disrupt mass-production runs too frequently.

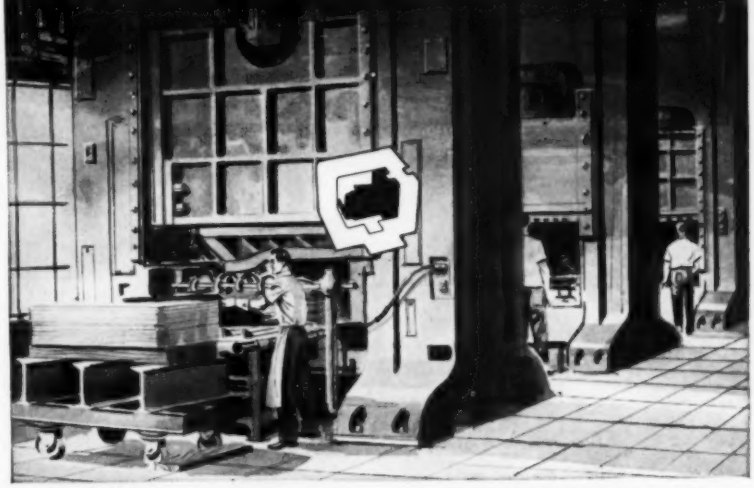
Dispatching

To carry out these shipping schedules and avoid flooring the output, a dispatch office is maintained at a central point in the shipping warehouse, next to the palletizing machines. The daily shipping schedule, broken down by carriers, and by products for each carrier, is revised each morning to make adjustments for deviations made from the previous day's schedule. A running inventory is kept of each product from day to day which tells the dispatcher at all times exactly how many cases of any product are on hand in the morning, how many are being produced and shipped on that day, and what the closing balance will be at the end of the day. He has this information at his finger tips for all 50 products throughout each of the two shifts the plant is operating.

In addition to watching these 50 products throughout his shift, the dispatcher must also know at all times what is going on in each of the 39 unloading and loading spots where the carriers are positioned for loading. This activity is disclosed to him on the electric control panel shown in *Fig.* 1. On this board, each one of the 28 car spots is indicated by a box car outline, and each of the 11 truck spots by a truck body outline. Each of these 39 carrier spots contains three little electric lights controlled by one of the 39 switches along the bottom side of the panel.

The three lights in each carrier are colored red, amber and green.

Potter & Brumfield *engineering is in this picture*



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Select the P&B Relay which helps make the difference

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Enclosed Power Relay
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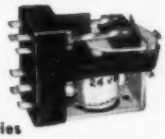
MW Series
Appliance Type Relay with
Above Average Performance
and Life.



AB Series
Appliance Type Relay,
Heavy Duty Construction.

Proper controls turn monsters into marvels . . . and controls are only as good as their components, such as relays. Without controls, this massive press, or any automated equipment, becomes a nightmare of disorganized force.

P&B AG Series relays are particularly suited to automation. They are ruggedly constructed for excellent shock resistance, withstanding 100 G shock without mechanical damage. The AG is a tough relay designed for rough jobs.

A metal enclosure keeps out shop dust and dirt. The phenolic base meets all U/L requirements for spacing and creepage distances . . . and the DPDT contact arrangement permits a wide variety of circuit variations.

For over 25 years, P&B has been building relays, and modifying existing types, to suit specific applications. Write for new catalog or engineering consultation.

P&B Standard Relays are available at your local electronic, electrical and refrigeration distributors

ENGINEERING DATA

SERIES: AG. Enclosed power relay for use in dusty or dirty applications.

CONTACTS: 3/16" dia. fine silver. Rated 5 amps., single break, 115 V. AC resistive. Rated 8 amps., double break, 115 V. AC resistive.

CONTACT ARRANGEMENTS: SPST NO-DM, SPST NC-DB, DPST-NO, DPST-NC, DPDT.

VOLTAGE RANGE: DC: 6 to 220 V. AC: 6 to 230 V.

COIL RESISTANCE: 30,000 ohm maximum.

POWER REQUIRED: 1.5 W. minimum DC at 25° ambient. 6 W. maximum.

AMBIENT TEMP. RANGE: —55° C. to +85° C.

TERMINALS: Screw type molded in phenolic base.

ENCLOSURE: Special dust cover.

DIMENSIONS: 2¾" L. x 2 11/32" W. x 3 5/32" H.

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You get extra dependability through circuit simplification, plus important savings in weight and space.

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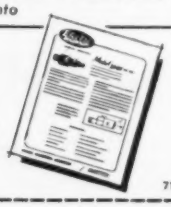
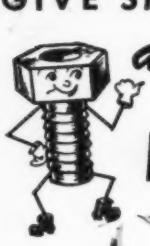
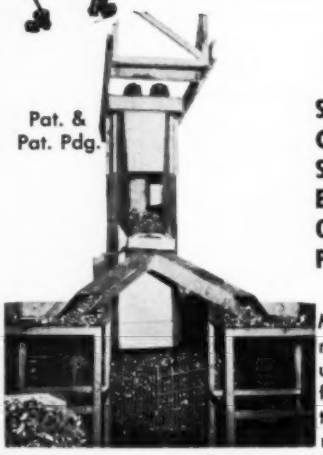


7164

GIVE SMALL PARTS A LIFT *automatically* with MAGNAVATOR® by PRAB





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SELF-FEEDING • VERTICAL HANDLING CONSERVES FLOOR SPACE • ELIMINATES MANUAL OPERATIONS • HOT PARTS HANDLED SAFELY

MAGNAVATOR eliminates manual labor usually required for filling hoppers and transferring between machines. Pictured here is just one of the many different jobs performed daily by MAGNAVATOR (automatic magnetic small parts elevator). This is a ceiling mounted unit (other mountings can be built to your needs) and is just one of many applications — yours may differ. MAGNAVATOR can handle up to 8,000 lbs. per hour, serving two or more machines for further operations. A feature of prime importance is the economy of floor space savings effected by MAGNAVATOR. If your production components include any small parts up to 8 lbs. each, such as: Castings, bolts, nuts, forgings, rivets, stampings, etc. — you can radically reduce materials handling costs with the installation of an automatic MAGNAVATOR.

MAGNAVATOR®

- IS SELF FEEDING
- MAINTAINS MATERIAL LEVEL AUTOMATICALLY
- IS PORTABLE
- IS FUNCTIONALLY STYLED

Shown here, a few suggested uses of MAGNAVATOR. PRAB engineers are ready to solve your materials handling problems effectively and make possible important costs savings. Just write, wire or phone . . . we'll be glad to tell you more.

Write for Catalog #500

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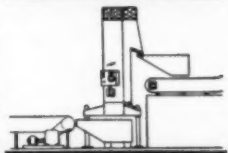
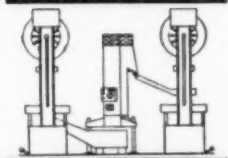


TRANSFERRING PARTS CONVEYOR TO CONVEYOR



TRANSFERRING SMALL PARTS BETWEEN PRESSES

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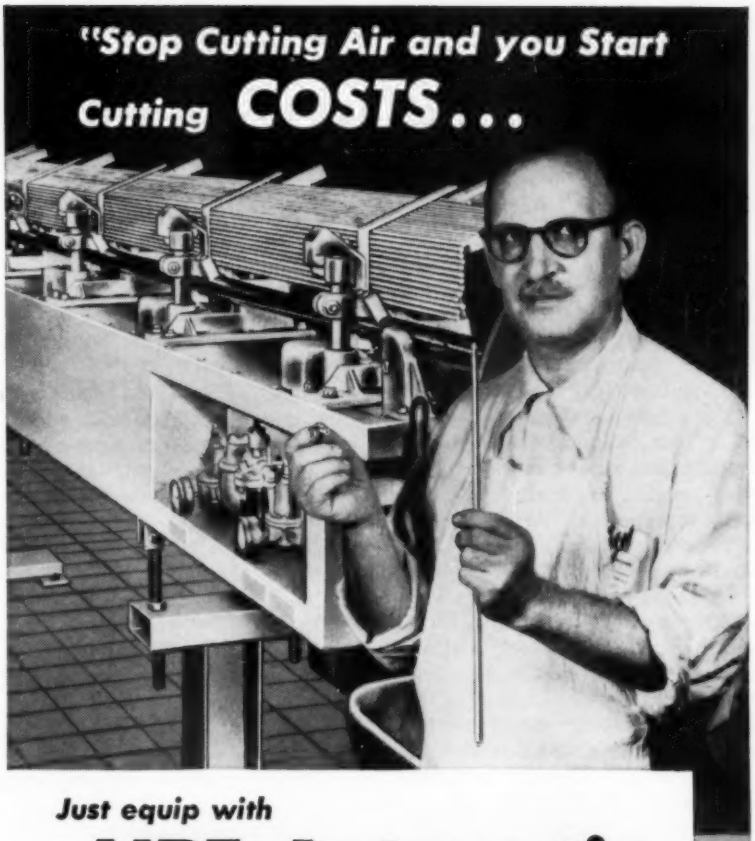
All three can emit a steady light, and two of them (the red and the green) can also give a blinking signal instead of the steady light, if desired. The significance of these five light signals for each carrier spot is given in the lower left-hand corner of the panel.

As a foreman on the rail dock or trailer dock starts or ends an operation in any of the spotted carriers, he time-stamps a punch card pre-written for this carrier and drops it into a box. Every half hour or so, these cards are all brought into the dispatcher's office. Using these punch cards as his cue, the dispatcher then turns the knobs at the bottom of the shipping control board to make the light signals indicate the unloading and loading status in each carrier.

Through the medium of these blinking lights and colored signals, therefore, the dispatcher sees and regulates by push buttons the unloading and loading operations taking place at one time in 28 rail cars and 11 road trucks extending over three tracks, and along three city blocks, as well as on different sides of several buildings. At one glance he can tell: (1) What cars and trucks are waiting to be unloaded; (2) which ones are actually unloaded; (3) which are empty; (4) which are actually being loaded; and (5) those that are ready to roll.

From this push-button panel he directs the flow by fork trucks of hundreds of palletized loads of beer cases being fed by five automatic palletizers, or taken out of storage on occasion, by fanning them out to the 39 loading spots as scheduled to fill solid and mixed carloads and truckloads. By integrating the trucking of these palletized loads of filled cases from the palletizers direct to the outbound carriers with the opposite flows of palletized loads of incoming cans and returned cases of empty bottles, this brewery has been virtually transformed from a case-by-case establishment to a modernized plant handling its output on a ton-by-ton basis.

From a paper entitled, "Pushbutton Carloading in a Palletized Brewery" presented at the Annual Meeting of the American Society of Mechanical Engineers in New York, Nov. 1956



Just equip with

LIPE Automatic
MAGAZINE LOADING BAR FEED"

Says Foreman Billy Smathers*

"We put in two Lipe AML Bar Feeds as a test," explains Foreman Smathers. "At the same cutting speeds as our other screw machines, the AML-fed machines turned out the two pieces I hold in my hands, 78% faster for the small ⅞" piece, and 108% faster for the 16" piece. That opened our eyes . . . but quick! Yet the reasons were perfectly obvious. The Lipe AML's fed stock without pausing. No cutting air. No repeat motion for feed-outs. No down-time for changing feed fingers, or for remnant disposal. The AML's geared our production to the steady pace of the clock . . . so many units of output per so many units of time. Overall, the gain was astonishing!"

WRITE OR WIRE for a FREE Lipe Sales Engineering estimate of production increases, savings and amortization time of Lipe AML Bar Feeds in your production layout.

* Photographer's models and pseudonyms used to protect company identity and confidential information.

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Machine Tools • Heavy-Duty Automotive Clutches • Portable Power Hack Saws

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PURCHASING MACHINE TOOLS

By S. E. SCHARF
District Supervisor of Industrial Engineering
Ernst & Ernst

MANY ENGINEERS and many members of top management have habitually justified the purchase of new tools or equipment on the basis of direct labor savings and upon that alone. Their reasoning is apt to be: "We can pay out the purchase price of this tool with direct labor savings in four years. Since it has a normal useful life of ten years, this is a good deal."

The calculations made to arrive at a four year payout might be made on the back of an envelope, or they might be fairly elaborate. Let's suppose that the purchase of a general purpose automatic tool which would be used for machining a variety of parts is under consideration. In such a case a sampling technique might be used, and our engineer would select a typical part for analysis, and apply the factors derived to the gross contemplated load, as a check against the claims which the tool salesman has made.

The tool salesman has calculated that the new tool will replace three old tools on a shift for shift basis, and has arrived at a four year payout as follows: He computes a net installed cost of $73,000 for one new machine. On a 2-shift basis, the new machine labor represents a 4 man-shift saving. In a 40-hour work week, at $2.25 per hour, annual labor savings in 52 weeks would be $18,720. He divides $73,000 by $18,720 and comes up with a 3.9 (say 4) year payout period.

The part selected for analysis by our engineer has an average monthly usage of 100 pieces and is run in lots of 200. Setup time has averaged one hour and running time about 0.4 hours per piece. He computes the present labor cost per piece at $0.91 in the following manner: Total man-hours per lot of 200, including setup and run time, are 81. This equates to 0.405 hours per piece, or $0.91 labor cost per piece at the same labor rate of $2.25 per hour.

Realizing that setup time on the new automatic would be greater, and influence economic lot sizes, he calculates the labor cost per piece based on a 6 month supply run: For a lot of 600 pieces on the new machine, assuming a 6-hour setup interval and an 0.11 hour run time per piece, our engineer estimates a total labor requirement of 72 man-hours or 0.120 hours per piece. At $2.25 per hour, therefore, the new machine has a predicted labor cost of $0.27 per piece.

He compares the $0.27 labor cost with the $0.91 labor cost on the old tool, and comes up with a ratio of predicted to present labor cost of 0.3. This ratio confirms the salesman's figures and our engineer concludes that it would be a four year payout.

Average Inventory Value

However, this engineer has a boss who is not so easily satisfied and who requests that further investigation be made. He suggests that the company's cost accountant should be consulted. Together, the engineer and the accountant delve into other factors. They decide immediately that there would be a marked effect on inventory. The accountant knows that it costs the company about 15 per cent of average inventory value to carry that inventory for a year, what with interest on investment in inventory, insurance, occupancy costs, etc.

To arrive at the effect of this expense, they determine that factory overhead applicable to the labor costs being considered, is 105 per cent (exclusive of depreciation on machine tools), and that the material cost per piece being considered is $2.35. The factory costs resulting from applying these factors are $4.22 on the old machine and $2.90 on the new machine (see TABLE 1).

They determine average inventory levels under the two conditions and, allowing for cushion stock, decide on 125 pieces for the old machine and 350 pieces for the new, which result in average investments in inventory of $528 and $1,015, respectively. Applying the 15 per cent carrying cost figure to these amounts, they arrive at costs of $79 and $152 per year, respectively, for the typical part selected for analysis. By relating these figures to the labor content of the 1200 pieces of this part needed annually they determine that the ratio of inventory carrying costs to labor costs are 0.073 and 0.468. By applying these ratios to the respective total annual payrolls pertaining to these machines under the two conditions, they determine that it will cost about $2,350 per year additional to carry the increased inventories due to larger sizes of runs on all parts processed on the new machine.

Interest on Capital

The accountant then calls attention to the fact that the company is operating partially on borrowed capital and is paying 5½ per cent interest on those borrowings. They assume that the debt which the company would incur to purchase the tool would be repaid over a period of about 7 years based on past debt repayment records. Thus, interest payments will average 5½ per cent of one-half the initial principal amount or about $2,000 per year for 7 years.

This is not the first automatic tool the company has purchased,

Table 1—Cost To Carry Inventory

Cost Factor	Old Machines	New Machine
Labor cost per piece of typical parts	$ 0.91	$ 0.27
Overhead @ 105 per cent	0.96	0.28
Material cost, per piece	2.35	2.35
Total factory cost	$ 4.22	$ 2.90
Average inventory level (pieces)	125	350
Average inventory investment	$ 528	$ 1,015
Carrying cost per year @ 15 per cent	$ 79	$ 152
Total labor cost on annual supply of 1200 pieces of typical part	$ 1,090	$ 325
Ratio of carrying costs to labor	0.073	0.468
Total annual wages for all parts	$28,080	$ 9,360
Corresponding carrying costs	$ 2,050	$ 4,400
Difference		$ 2,350

and our engineer decides to find out what effect such tools have had on indirect labor costs. Conversations with plant supervision and a review of the indirect labor analyses prepared weekly indicate that automatics increase indirect labor costs among tool room employees and among maintenance personnel.

They estimate that the preparation of jigs, fixtures and tooling not included in the original purchase price of the machine, the maintenance of such jigs, fixtures and tooling, and the maintenance of the machine itself will require about one-half of a man's time, as annual average. They evaluate that time at $3.00 per hour, or $3150 per year. Past records indicate that the three old machines consumed about $1800 per year of tool room and maintenance personnel time. Thus, an additional expense of $1350 per year would apply against the new machine.

TABLE 2 illustrates the adjustment which must be made to the original estimated payout period as a result of the three calculations we have outlined. It will be noted that the $18,720 originally estimated as applicable to payout has been reduced by some $5700, and that only $13,020 is now applicable to payout. The original 4 year payout has changed to a 6 year payout.

Other Factors

The three calculations we have just outlined do not include all the factors which affect factory costs. Suffice it to say that there are other factors, both favorable and unfavorable, which should be considered. To name a few: savings due to reduced material costs resulting from quantity purchases to conform with larger lot sizes; effect on material handling costs; effect on "balance" of shop; space saved or lost; power and other utility costs; quality control and inspection costs; effect on overtime premium.

Regardless of what factors are or are not considered, the payout theory, as generally applied, concerns itself primarily with items which appear above the gross profit line on the operating statement. (In the example cited interest on borrowed capital would be

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Preselective automatic positioning anywhere within a 50" x 30" area.

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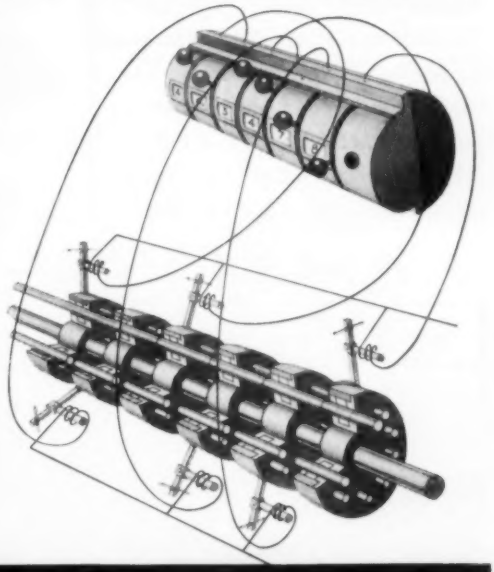

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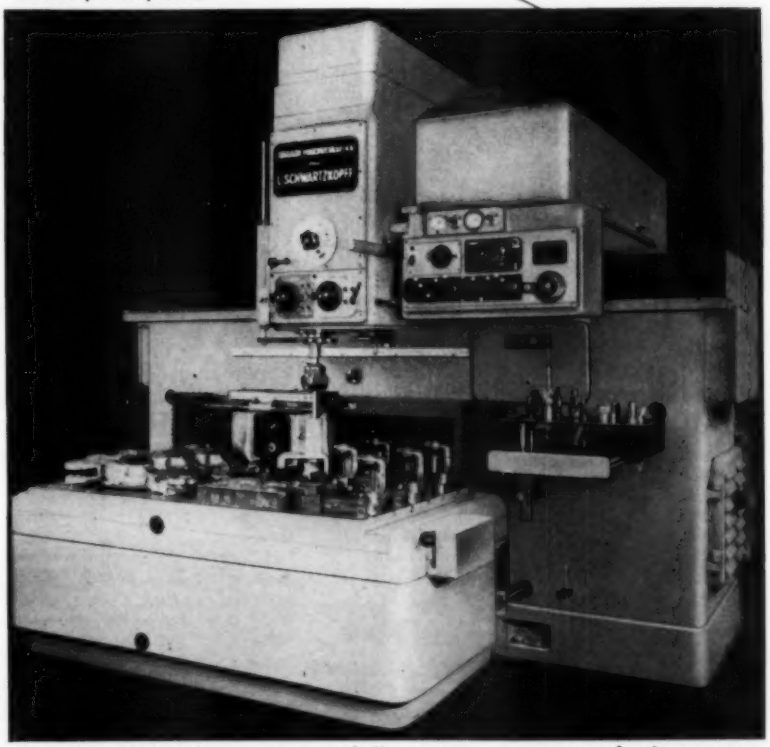

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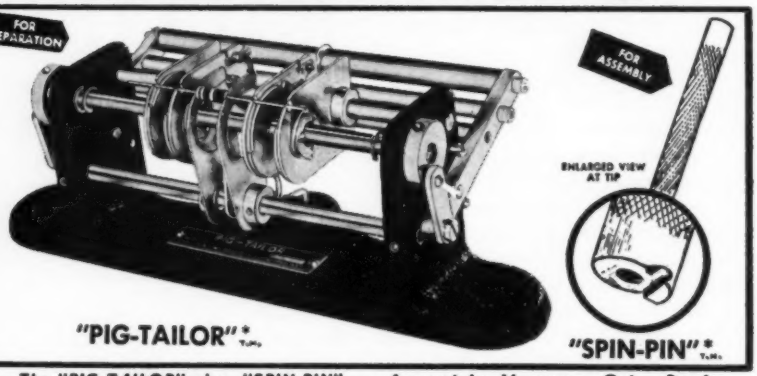

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PIG-TAILORING eliminates:

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* PATENT PENDING

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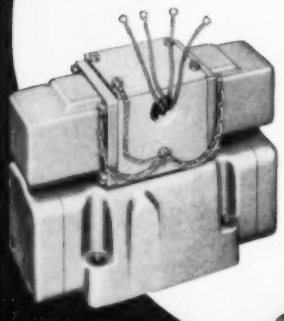

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one exception.) The result obtained is not always such as to enable a sound decision. It is obvious that if calculations indicate a 15 year payout on a machine with a life expectancy of 10 years, the purchase would be ill advised. The difference between a 4 year and a 6 year payout is not quite so obvious.

The results of such calculations do not always lead to obviously sound decisions because of the failure to take into consideration the effect of the purchase on profits and on the financial position of the company. They also fail to take into consideration certain intangible items, particularly obsolescence of equipment or product. Our accountant realizes these facts and makes some calculations while the engineer looks on with interest.

He first computes the effect the additional indebtedness would have on the operating ratio of the company. He determines that this ratio of current assets to current liabilities has been averaging close to 2.6 and that the additional indebtedness would reduce this ratio to about 2.2 at the lowest. He concludes that this is acceptable.

He next reviews probable cash requirements to determine if the company will be required to borrow money within the next few years for ordinary operating capital, and if so, what effect a loan of $73,000 would have on the borrowing ability of the company. He determines that any such borrowing as may become necessary would be small and short term, and decides that the 2.2 operating ratio would permit such borrowing.

Then he and the engineer delve into the problem of profits, and are immediately knee-deep in discussions of depreciation, income taxes and obsolescence. The accountant explains that depreciation is a different kind of expense, a non-cash expense, or money which the firm pays to itself, so to speak. He explains that, even though different, it is an expense and that it has its effect on profits and on income taxes.

The engineer cautions that progress in the field of automation is rapid and that obsolescence of equipment might prove to be a real factor. After referring to tax regulations, they decide to compute de-

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preciation on a 10 year life basis, using one of the three ways or methods of computing depreciation which are allowed under present federal tax regulations. (The selection of any one is optional, as long as it is applied to a new capital asset with a life of three years or more. The straight line method may be used on any depreciable asset.)

Depreciation Methods

Briefly, the three methods are:

1. The "straight line" method, where the same amount of depreciation is taken in each year of life of the asset.

2. The "double declining balance" method, where a percentage, equal to twice the average per cent of depreciation, is applied to the undepreciated balance each year. This method would never fully depreciate an asset if carried through indifinitely. Therefore, at some point a switch is usually made to the straight line method. In this instance, the switch was made after the fifth year.

3. The "sum of the digits" method, where numbers, representing the years over which the asset is to be depreciated, are added together to determine the denominator of a fraction. This denominator is held constant and a different numerator is determined for each year and the resulting fraction is applied to the depreciable amount. For the first year the number of the last year is selected as the numerator, for the second year the number of the next-to-last year is used. In this instance (a 10 year life) the constant denominator is the sum of 1, 2, 3, etc., to 10; or 55. The numerator for the first year is 10, for the second 9, etc. Thus, for the first year, 10/55 of $75,000 is $13,636.

Based on their estimate of the obsolescence possibilities they decide to use the sum of the digits method. This selection is made because obsolescence within two or three years is not anticipated, while obsolescence within five to seven years seems much more likely.

Table 2—Adjustment of Original Payout Figures

Cost Factor		New Machine
Estimated annual saving in direct labor		$18,720
Additional cost to carry inventory	$2,350	
Interest on borrowed capital	2,000	
Increased tool room and maintenance labor	1,350	5,700
Net applicable to payout		$13,020

$78,000/$13,020=6 year payout

Their earlier calculations relating to payout excluded depreciation from consideration. It now remains to determine the effect of depreciation on payout and profits. They assume a probable salvage value of $3,000, leaving $75,000 to depreciate. In TABLE 3 are tabulated the net amounts applicable to payout, the additional depreciation expense, and the probable increase or decrease of profits which could be attributed to the purchase. It will be noted that over the ten years of depreciable life of the machine, the increase in profits would be $61,200 or an average of $6,120 per year. This is about one-third of the original figure derived in determining a 4 year payout. The figure $61,200, for the ten year period would apply regardless of the depreciation formula selected. However, the figure for individual years would vary greatly.

It is interesting to note that TABLE 3 shows a "loss" for the first year, using the sum of the digits method of computing depreciation, and that profits do not become sizable until several years have passed. Had the straight line method been used, the first seven years would have shown profits of $5,520 per year. Then, we might ask, why select a rapid depreciation formula? Why not take a chance on obsolescence and let it go at that?

The answer is that we are trying to save income tax money. If the company in question is a corporation operating at a profit it will be paying about one-half of those profit dollars to the government in taxes. By selecting a rapid depreciation method we are reducing the amount of taxes we

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■ Save manpower. Cut material handling costs between machines and work stations. Remove work pieces from one machine and transfer to another automatically. The Transfer Conveyor is easily adjusted to your machines' production speeds to assure maximum production efficiency. For practical recommendations on your specific parts feeding problem, send prints or sample parts.

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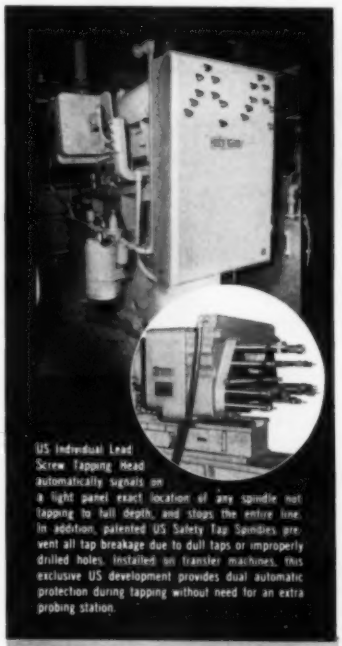
The U. S. Drill Head Co.'s new electronic device seeks trouble too—in automated production lines. It locates faulty machining during a "transfer setup" and stops the machine *before* succeeding operations are begun. It minimizes the chance of costly smash-ups and resulting expensive down-time . . . reduces re-operating and scrap-loss costs.

It is another precision cost-reducing "tool" from the largest exclusive drill head builder in the world.



US Individual Lead Screw Tapping Head automatically signals on a light panel exact location of any spindle not tapping to full depth, and stops the entire line. In addition, patented US Safety Tap Spindles prevent all tap breakage due to dull taps or improperly drilled holes. Installed on transfer machines, this exclusive US development provides dual automatic protection during tapping without need for an extra probing station.

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must pay in the early years, and taking a chance of what taxes we would have to pay in later years. Since it is easier to foresee with accuracy conditions for a few years than for several years, many companies who are operating efficiently and profitably now elect to take a chance on their tax situation some years down the line and therefore select a rapid depreciation formula. At best such a selection is a risk, but there seems to be less risk involved by taking what you can now and leaving the later years to chance. Companies which are not operating at a profit, especially young, growing companies, would probably shun rapid depreciation formulas and hoard as much depreciation expense as possible for the later years which they hope will be more profitable.

The type of calculations we have reviewed could be made for each of several alternate tools in order to determine which tool to purchase, if any. The example of analysis we have used is, of course, crude and oversimplified. The figures may or may not be realistic, depending on many factors not even mentioned. However, the example has served to indicate that there are factors, other than savings in direct labor, which should be considered when selecting a new tool or piece of equipment. Many of these factors are subject to quantitative analysis.

Table 3—Effect of Purchase on Profits

Year Number	Net Amount Applicable To Payout	Additional Depreciation Expense	Increase or (Decrease) of Profits Each Year	Cumulative
1	$13,020	$13,636	$ (616)	$ (616)
2	13,020	12,273	747	131
3	13,020	10,909	2,111	2,242
4	13,020	9,545	3,475	5,717
5	13,020	8,182	4,838	10,555
6	13,020	6,819	6,201	16,756
7	13,020	5,454	7,566	24,322
8	15,020	4,091	10,929	35,251
9	15,020	2,727	12,293	47,544
10	15,020	1,364	13,656	61,200
	$136,200	$75,000	$61,200	

I do not wish to give the impression that new and improved tools and tooling are not profitable; in many instances a company could not survive unless the most advanced and efficient tools available were purchased and used. Rather, my purpose has been to give the engineer an idea of some of the many factors top management looks at when considering new equipment. By giving consideration to all such factors one of you may be able to avoid buying expensive, new equipment with the expectation of seeing immediately favorable results in the operating statement when such results cannot in fact be realized. An error of this nature could throw cold water on management plans for further expenditures which would actually prove beneficial under a full analysis.

From a paper entitled, "Some Economics Aspects of Machine Tool Selection" presented at the Twenty-Fifth Anniversary Meeting of the American Society of Tool Engineers, Houston, Texas, March, 1957.

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Any number of units may be employed. Examples of the various ways in which they may be arranged are shown at the right.

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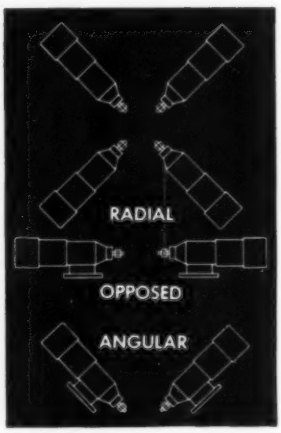

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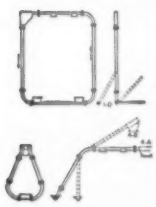
Examples of a few typical circuit plans.



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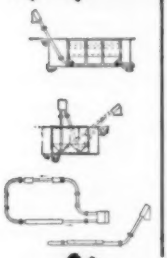

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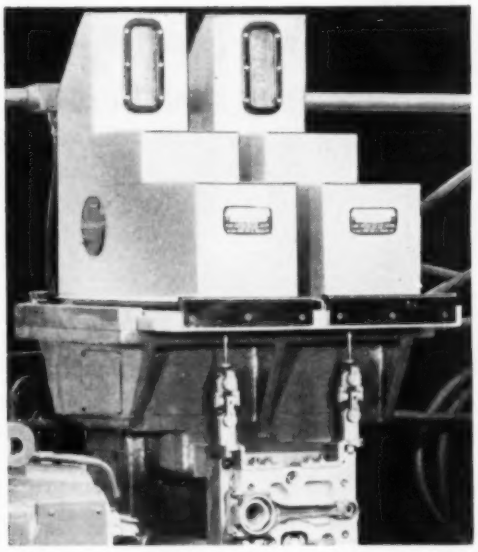
Another report on

Exact Weight Scales

in Automation



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MECHANISMS AND DYNAMICS OF MACHINERY

By Hamilton H. Mabie, and Fred W. Ocvirk, associate professors of mechanical engineering, Cornell University; 442 *pages,* 5¾ *by* 9 *inches, illustrated, clothbound, published by John Wiley & Sons Inc., New York; available from* AUTOMATION; $8.50 *postpaid.*

Because of the increased speeds and needs for better design inherent in automatic machine developments, the subject of mechanisms and dynamics of machinery is worthy of continual review. This text includes material which has been used for several years in undergraduate courses at Cornell University. Topics covered include linkages, gearing, computing mechanisms, force analysis and balance of machinery, and vibration in machines.

THE OFFICE IN TRANSITION

By Esther R. Baker, instructor, Rutgers University, and Eugene F. Murphy, automation consultant, Management Institute, New York University; 190 *pages,* 5½ *by* 8¼ *inches, clothbound, published by Harper & Brothers, New York; available from* AUTOMATION; $3.50 *postpaid.*

This book for businessmen and others concerned with office management describes the extent and degrees of automaticity in the modern office and discusses the problems, human and technical, that can arise in the course of introducing automation. Useful appendixes describe equipment available and give sources for both equipment and information relating to office automation.

Association Publication

PROCEEDINGS OF THE RETMA SYMPOSIUM ON RELIABLE APPLICATIONS OF ELECTRON TUBES

Paperbound, 105 *pages,* 8½ *by* 11 *inches, illustrated; available from Engineering Publishers, GPO Box* 1151, *New York* 1, *N. Y.;* $5.00.

Conference discussed means to increase reliability of electronic equipment by increasing the reliability of the tubes used. Circuit design to improve reliability, use of field experience to aid in equipment design, and improvements in specifications of the tubes themselves were considered. Texts of papers presented and a panel discussion on tube specifications and reliability are covered in this report.

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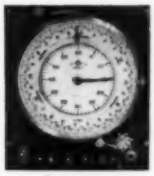
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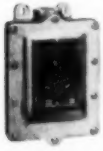
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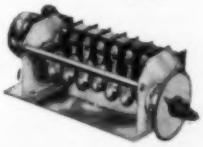
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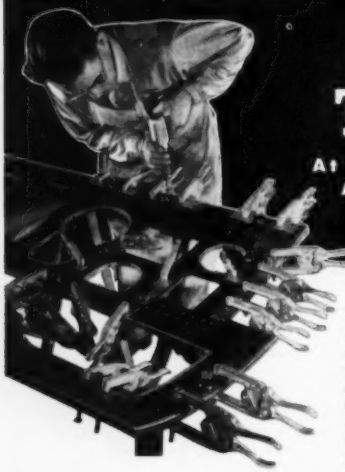

The picture above shows two sizes of dependable Knu-Vise clamps as they are used on a setup designed by North American's tooling specialists. Operation is the assembly of a bulky, hard-to-handle fuselage section of a F-100 Super Sabre.

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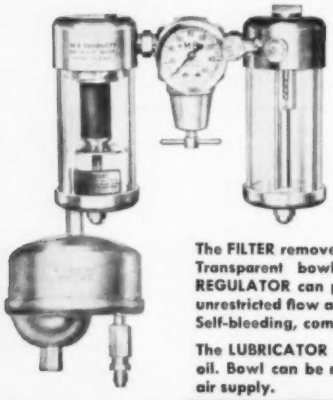

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AUTOMATION patents

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APPARATUS FOR PRODUCING SHELL MOLDS

Several patterns for making molds are carried by a means for moving them through an investment station, an oven, and back to the investment station, with means to remove the coating of molding mixture after curing in the oven. Patent 2,778,-073 by Robert D. Cheyne, assigned to Polygram Casting Co. Ltd., London, England.

LOG CONVEYING

Apparatus conveys logs through a conduit from a pond to an elevation higher than the pond by use of a high pressure water jet and a venturi throat in the conduit. Patent 2,778,692 by Clifford Makinson, assigned to Terry Machinery Co. Ltd., Montreal, Canada.

APPARATUS FOR EQUALIZING TENSION IN ELASTIC RIBBON

Uniform tension is obtained in a moving band of elastic ribbon by passing it around stationary pins and small, large and intermediate-sized pulleys on a common shaft subject to braking drag. Patent 2,779,552 by Philip L. Jarvis, assigned to Jarvis Mfg. Corp.

MECHANISM FOR CONVERTING ROTARY MOTION TO INTERMITTENT UNDIRECTIONAL MOTION

A radially slotted wheel, driven intermittently by a drive pin on a rotating drive wheel, is locked in its rest position by a locking bar drawn into one of the slots as the drive pin disengages the slotted wheel. Patent 2,784,599 by Norbert L. Moulin, assigned to Magnavox Co.

AUTOMATIC MACHINE TO TEST AND CORRECT FOR DYNAMIC UNBALANCE

Testing mechanism develops electrical signal proportional to angular position of unbalance of workpiece and the piece is automatically positioned for corrective drilling. Patent 2,779,217 by John R. Stovall Jr., George C. Lawrie, and Albert F. Craig, assigned to Tinius Olsen Testing Machine Co.

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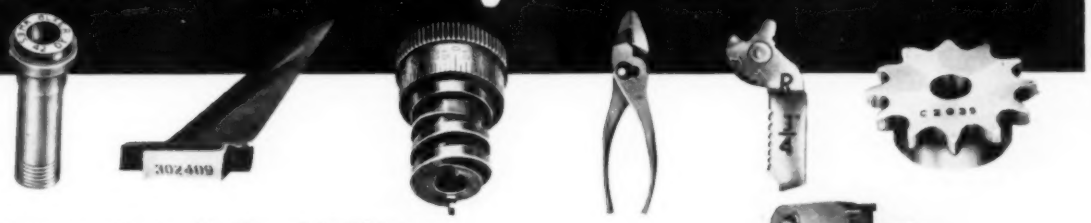

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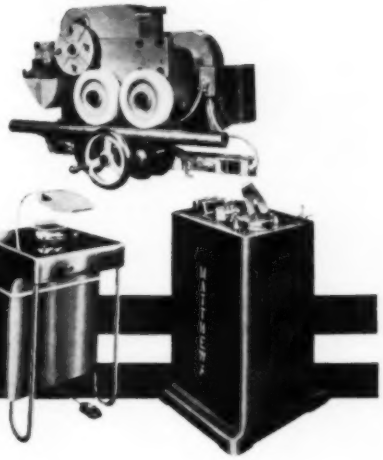

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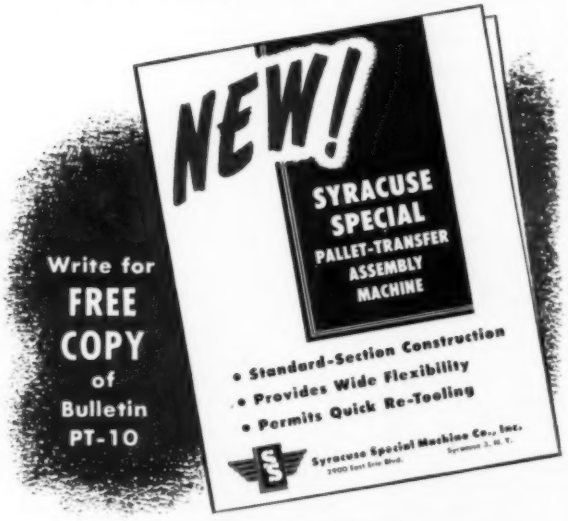

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AUTOMATION • problem forum

Readers with problems concerning systems, equipment or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Solution suggestions should refer to case number and title of the problem involved.

Since the inception of AUTOMATION magazine, many readers have outlined problems to the editors and inquired about sources for information and hardware to solve their problems. Knowing that some of the best production innovations contributing to success have been adapted from the experiences of others, often in widely diverse industries, the editors have been actively applying this cross-fertilization process as one of the important approaches to effective and economical automation. In the exchange of such information there is opportunity to stimulate additional interchange of useful data. To provide this extra editorial service we are inaugurating in this issue a regular department devoted to questions and suggestions concerning systems, equipment and components for automated operations.

Readers having specific questions or problems are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. To develop practical solutions, problems will be published identified only by a case number and descriptive title. Suitable suggestions will be welcomed and should refer to case number and title of the problem involved. Suggestions and solutions to problems will be transmitted promptly and pertinent excerpts will be published in succeeding issues.

Some questions for which answers are presently sought are included in this column. We hope that AUTOMATION readers having suggestions or equipment to suit the needs, or having questions of their own, will participate freely in this forum and assist in the general advancement of the technology.

Case No. 1168-P
Conveyorized Storage

. . . I was reading a report dealing with a garage where automobiles were taken onto some sort of conveyor belt and moved into vacant storage areas and were recalled for delivery to their owners. I felt that perhaps you could put me in touch with a company who might deal with a storage problem similar to that mentioned above, but with particular application to our own industry.

We have in storage at our plant some 10,000 cardboard and wooden cases. These cases weigh on an average 300 lbs., with a maximum weight of about 500 lbs. Their sizes vary from 10 by 10 by 37 inches to 12 by 12 by 62 inches for a few of our biggest cases.

Hope that you can put us in touch with a company that would handle a problem such as this . . .

Textile Company

♦ ♦ ♦

Case No. 1156-P
Index Sheets and Tabs

. . . we would like to be put in touch with companies that can build automatic machinery which will produce plastic index strips and sheets with tabs attached. At the present time, these items are manufactured by hand labor and semiautomatic equipment.

In the case of the index sheets we need a machine that will affix the acetate, reinforce and punch the sheets in a continuous operation. For the plastic strips, we require a machine that will have a continuous process of creasing and folding with an adjustment allowing for strips of from 6 to 12 inches in length. We would also like an added feature of having an adjustment to vary the size of the narrower part of the strip.

Any information or help will be greatly appreciated . . .

Vice President

♦ ♦ ♦

Case No. 1078-P
Water in Oil

. . . it is my understanding that the petroleum industry has developed a monitoring device, based on capacitance principle, which is used to detect the presence of excess quantities of water in oil which is being pumped.

I would appreciate any detailed information about the operation of such a device . . .

Food Processor

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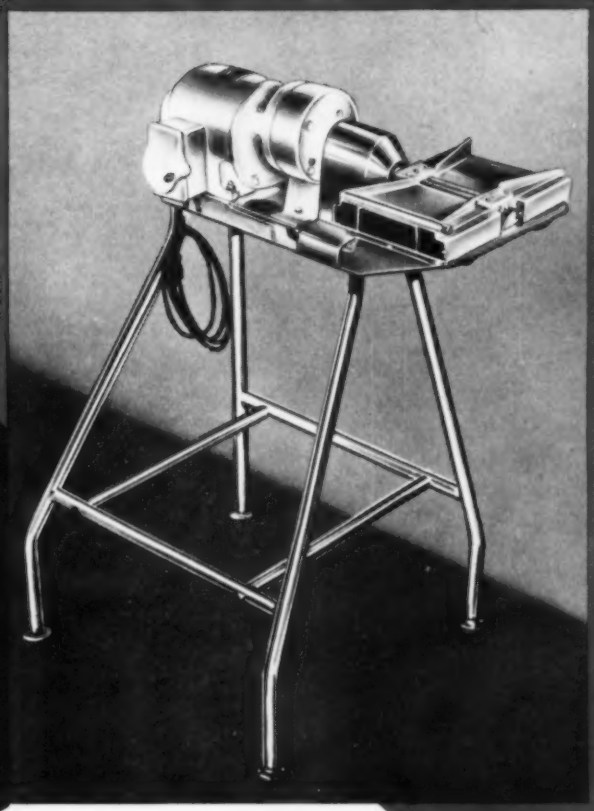

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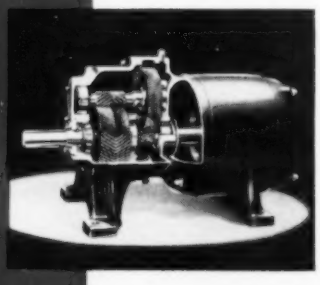

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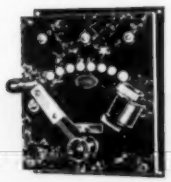

The "Kitty Hawk" of Automation

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New ideas are seldom as new as most people think. Automation is typical. If automation is tomorrow's way of manufacturing, this *tomorrow* dawned 65 years ago with the beginning of automatic electrical control. What is now possible in automation is not the result of sudden discovery but the application of control techniques and equipment developed through *decades* of experience.

This is an important consideration to anyone interested in automation planning. Automation is always a major project. It requires a large investment in planning and engineering . . . and an outlay for equipment often without precedence in a company's experience. The rewards for success can be momentous. But the penalties for mistakes can be disastrous.

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